NATIONAL MUSEUM OF VICTORIA

THE JOURNAL of The Department OF AGRICULTURE

VICTORIA · · · AUSTRALIA

Vol. XXXV.—Part 8. AUGUST, 1937. PRICE, 3D.

FEEDING PIT SILAGE

Registered at the General Post Office, Melbourne, for transmission by Post as a Newspaper

FOOT-ROT IN SHEEP

For prevention and satisfactory treatment by Foot-bath process—use

"ARZEEN"

"Vallo" Powder SHEEP DIP

AND

VALLO "Dual Purpose" QUICK ACTING SHEEP DIP

Vallo "Dual Purpose" Quick Acting Dip has the same lasting properties as Vallo Powder Sheep Dip. It not only completely exterminates the live tick, but also sterilizes the eggs, preventing them from hatching out.

Drenching Sheep and Lambs

Formulæ recommended by the McMaster Laboratory and State Departments of Agriculture and Stock

USE "Vallo" Nicotine Sulphate 40%
USE "Vallo" Neige Copper Sulphate

Manufacturers—

VICTOR LEGGO & FARMERS LTD.

Phone: Central 1243 — **222 Queen Street, Melbourne, C.1** — G.P.O. Box 508 H

WEED, SCRUB, and TREE KILLERS

"VALLO" PENTOXIDE

LIQUID 36% As_2O_5
GRANULATED 84% As_2O_5

ARZEEN

LIQUID 48% As_2O_3
POWDER 80% As_2O_3

Highly Concentrated Preparations of

SOLUBLE ARSENIC

READY FOR IMMEDIATE USE

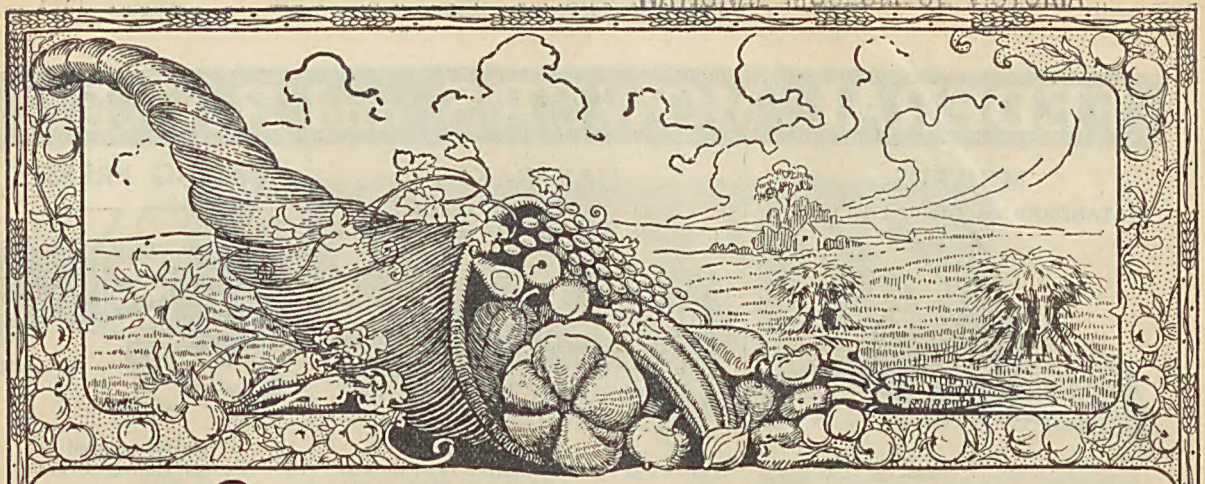
The most effective and economical weed-killers. Eradicates blackberries and all other noxious vegetation. Completely kills useless timber and prevents growth of suckers.

Supplies Obtainable All Stores. — *Write for Particulars, Dilutions, &c.*

VICTOR LEGGO & FARMERS LTD.

Phone: Central 1243 — **222 Queen Street, Melbourne, C.1** — G.P.O. Box No. 508 H

NATIONAL MUSEUM OF VICTORIA



Contents.

AUGUST, 1937

		PAGE
Subterranean Clover—Strains	*J. E. Harrison, B.Agr.Sc.*	365
Insect Pests of Subterranean Clover	*R. T. M. Pescott, M.Agr.Sc.*	371
Chicken Feeding Test—Chick Mixture *v.* Soaked Grain	*W. O. Pederick and A. G. Clark*	376
Codling Moth and Black Spot Control—Apple and Pear Demonstration Plots, 1936–37		377
Butter Production and Export		394
Orchard and Garden Notes	*E. E. Pescott, F.L.S.*	395
Grain Crops—World Production and Trade		396
Professional Papers: Citrus Red Scale—Progress Report on Investigations, 1936–37	*K. M. Ward, M.Agr.Sc. and C. J. R. Johnston, B.Agr.Sc.*	397
Tubercle Free Herds		416

Issued under the direction of the Hon. E. J. Hogan, M.L.A., Minister of Agriculture.

COPYRIGHT PROVISIONS AND SUBSCRIPTION RATES.

The Articles in the Journal of the Department of Agriculture of Victoria are protected by the provisions of the Copyright Act. Proprietors of newspapers wishing to republish any matter are at liberty to do so, *provided the Journal and author are both acknowledged.*

The Journal is issued monthly. The subscription, which is payable in advance and includes postage, is 3s. per annum for the Commonwealth and New Zealand, and 5s. for the United Kingdom and Foreign Countries. Single copy, Threepence. Subscriptions should be forwarded to the Director of Agriculture, Melbourne, C.2.

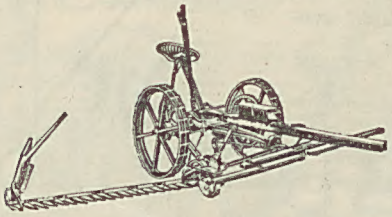
POSTAGE RATES.

The postage required for this issue is:—To Australia and New Zealand, 1d.; to United Kingdom via France, 2d.; to United Kingdom via All-sea route, 1d.; to other British Possessions, 2d.; to U.S.A. and Foreign Countries, 3d.

FEDERAL MOWERS and RAKES

MOWERS

STANDARD and OIL BATH TYPES



BALL BEARINGS, ROLLER BEARINGS, PHOSPHOR BRONZE BEARINGS carry shafts made to very exact limits, some to one-thousandth of an inch, preventing knock and ensuring long and satisfactory life.

ALLOY STEEL, heat-treated similar to motor practice, is used on all parts subject to stress.

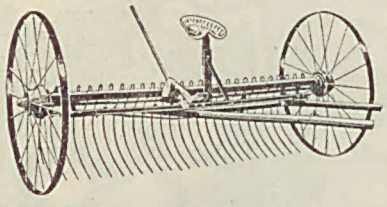
STEEL CASTINGS—practically UNBREAKABLE—are used wherever cast iron would be liable to fail. PATENT SWATHBOARD enables tangled sub. clover to be easily cut. Turns swath over on itself and so preserves succulence.

You cannot buy a better mower, neither can you buy a cheaper.

HAY RAKES

ARE LIGHT, BUT STRONG

(Practically all wrought steel excepting shafts)

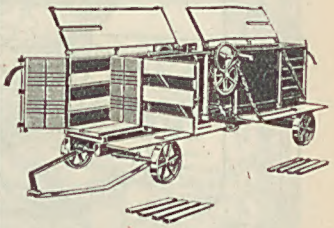


CLEAN RAKING AND POSITIVE TRIPPING year after year are what this Rake is certain to give you, because this design is right and because the stronger frame has the rigidity necessary to keep the tines level always, and so rake clean, and to keep the tripping parts always in correct relation, so that the tines lift the instant the foot pedal is pressed.

THE ALLOY STEEL TINES, ½-inch diameter, after heat treatment, are tested to strains far greater than they will ever get in the field.

WHEELS have staggered renewable spokes built on the suspension principle, securing lightest possible weight with greatest possible strength.

BALING PRESSES



Double-ended Power Baling Press

For Meadow Hay.
For Lucerne.
For Straw Sheaves.

Every stroke of the ram forward or backward is a power stroke. Bales are wired and ejected without effort.

This is a utility Baler mounted on strong undercarriage with turntable and can be drawn about the paddock from place to place. A 4-B.H.P. Engine is sufficient power to operate it. Ram and belt are automatically controlled.

T. ROBINSON & Co. Pty. Ltd.

Show Rooms: 536-538 BOURKE ST., Melbourne, Victoria
Sydney Depot: RAILWAY PARADE, BURWOOD, N.S.W.
Head Office and Works: SPOTSWOOD, W.14, Victoria

INDEX TO ADVERTISEMENTS

FRONT SECTION

Commonwealth Serum Laboratories ... viii
Dunlop Perdriau Rubber Co. Ltd.... ... vi
Gippsland and Northern Co-operative Coy. Ltd. (Seeds) vii
Goodyear Tyres ... ... opp. p. 372
Hardie, James and Co. Pty. Ltd. iv
International Harvester Coy. of Australia Pty. Ltd. (Separators) v
Leggo, Victor, & Farmers Ltd. ... inside cover
McKay Massey Harris Pty. Ltd. iii
Robinson, T. & Coy. Pty. Ltd. ii
Vacuum Oil Coy. Ltd. ... ... opp. p. 373
Wills, W. D. & H. O. (Aust.) Ltd. iv

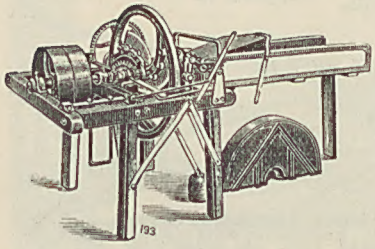
BACK SECTION

Australian Cement Ltd. ... ... inside cover
Clydesdale Stallion and Colts for Sale ... xiii
Cockbill, J. ix
Commonwealth Fertilisers and Chemicals Ltd. ix
Elder Smith and Co. Ltd. (Esa Bluestone) ... ix
General Motors-Holdens Ltd. (Chevrolet Trucks) ... ... opp. p. 409
Law Somner Pty. Ltd. ... ... opp. p. 408
Lysaght Bros. & Coy. Ltd. x
McGregor Wheel Grip and Engineering Pty. Ltd. ... ... outside cover
Paspalum Seed for Sale xvi
Red Poll Calves for Sale xii
State Savings Bank xvi
Stud Breeders' Cards xi
Trewhella Bros. Pty. Ltd. xvi
Victorian Railways xv

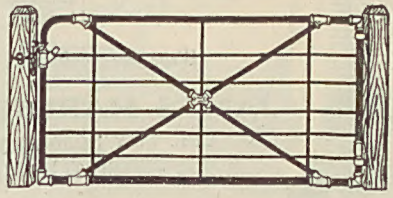
ALL-THE-YEAR-ROUND

SERVANTS

FOR EVERY FARMER



Saving you work, time, and money, day in, day out!



SUNSHINE CHAFFCUTTERS

Cut swiftly and safely

SUNSHINE CHAFFCUTTERS have stop motion and reversing gear; positive safety device; extended Rail and outer Bearings; Fast and Loose Pulleys and Belt Shifter. They cut 3 lengths of chaff. May be fitted with Short Elevator and Double Bagger Spouts, or with Long Elevator from 10 to 20 feet.

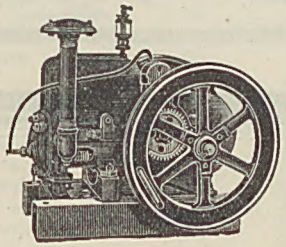
No. 4AX.—3-knife; approx. capacity 25 cwt. per hour; 8½-inch mouth.

No. 2X.—3-knife; approx. capacity 30 cwt. per hour; 9½-inch mouth.

No. 2XP.—(Portable) with Short Elevator and 2-Bagger Spouts.

Also, Model No. 5.—2-knife; approx. capacity 10 cwt. per hour; 8½-inch mouth.

Special Leaflets give full details; ask your local agent, or write direct



SUNDIAL FARM ENGINES

Power at next-to-no-cost

SUNDIAL FARM ENGINES are reliable, simple, and give greatest power at LOW FUEL COST. Horizontal type, 4 cycle, hopper-cooled. High-speed governor; high-tension magneto.

2 h.p.: Cylinder 4-in. bore by 4½-in. stroke.

4 h.p.: Cylinder 5-in. bore by 5½-in. stroke.

SUNSHINE FARM GATES

Light and Strong

Made of the best steel tubing. Light, strong, durable, and ornamental. Joints are chill-moulded—no threads, sockets, or bolts and nuts. Nothing that can be injured by exposure, nothing to shake loose during long years of constant use. They cannot twist or sag.

The following types are available:—

X Stay Gates (as shown), sheep-proof, 8 to 12 ft. wide.

X Stay Gates, with wire netting, rabbit-proof, 8 to 12 ft. wide.

XX Stay Gates, sheep-proof, 10 to 20 ft. wide.

XX Stay Gates, with netting, rabbit-proof, 10 to 20 ft. wide.

6-Bar Gates (Cattleman's favorite), 7 to 12 ft. wide.

Sheep-yard Gates. For 3, 4½, 6, 8, 10, and 12 ft. openings.

Also, Sunshine Garden and Car Entrance Gates.

Full details in special folder. Ask your local agent, or write direct.

H. V. McKAY MASSEY HARRIS PTY. LTD.

SUNSHINE HARVESTER WORKS, SUNSHINE, W.20

And at MELBOURNE, SYDNEY, ADELAIDE, PERTH, BRISBANE

Build with

HARDIE'S "FIBROLITE"

ASBESTOS CEMENT SHEETS

The ideal building material for Homesteads and Farm and Station Buildings of all types. Fire Retardant, White Ant Proof, Borer Proof, Weather Proof, IMPROVES WITH AGE!

Unrivalled for external walls, interior walls, ceilings, and partitions. Easily and quickly fixed—any handy man can erect "FIBROLITE." Supplied in 44 stock sizes. No waste. Less labour.

Write for sample, price list, and catalogue—FREE AND POST FREE!

JAMES HARDIE & COY. PTY. LTD.

CNR. CITY ROAD AND CLARENDON STREET,
SOUTH MELBOURNE

Smoke . . .

"LUCKY HIT"

TOBACCO

Plug and Cut

A BLEND CONTAINING CHOICE SELECTED AUSTRALIAN GROWN LEAF

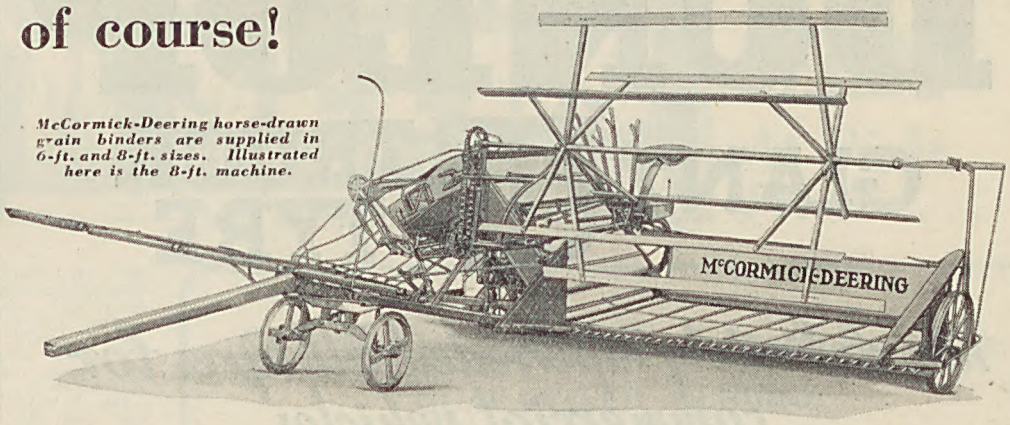
The British-Australasian Tobacco Co. Pty. Ltd.

And now

An OIL-BATH Binder . . .

McCORMICK DEERING

of course!



McCormick-Deering horse-drawn grain binders are supplied in 6-ft. and 8-ft. sizes. Illustrated here is the 8-ft. machine.

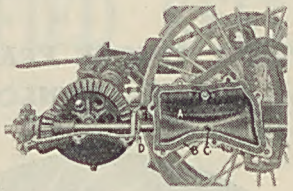
FOLLOWING the outstanding success of McCormick-Deering oil-bath mowers, International Harvester has pleasure in announcing that all McCormick-Deering horse-drawn grain binders are now equipped with totally enclosed main drive gears which operate in a deep bath of oil.

This new feature, which marks the greatest step forward in the manufacture of binders that has been made for many years, means that dust and dirt are totally excluded from the drive gears, which include the bevel gear and the bevel pinion. The gears operate quietly and efficiently, draught is reduced and the effective working life of the binder is greatly increased.

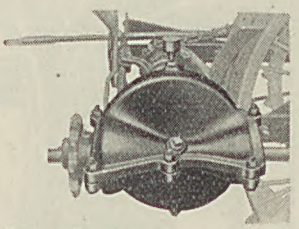
The Greatest Binder Value on the Market

The application of the oil-bath principle to the main drive gears — the gears which, as everyone knows, do the greatest amount of work on a binder — means that the McCormick-Deering — already recognized as the most outstanding grain binder on the market today — now offers the farmer still greater value in the way of efficient operation, long life and satisfactory service.

Let your new binder be a McCormick-Deering oil-bath binder. You need one of these modern binders on your farm. Go along to your McCormick-Deering agent and ask him for particulars or, if more convenient, write us direct and we will mail you an illustrated catalogue.



Showing the position of the enclosed main drive gears on the McCormick-Deering binder. The upper housing, A, has been removed to show B, the felt gasket between the upper and lower housings; C, the location of the screw filler plug in the upper housing; and D, the front felt oil retainer.



The enclosed gear case is made in two halves which fit together with a felt gasket between them, making the case oil-tight and dust-proof. New oil can be added and old oil drained off by removing the screw plugs, top and bottom.

INTERNATIONAL HARVESTER COMPANY

OF AUSTRALIA PTY. LTD.

(INCORPORATED IN VICTORIA)

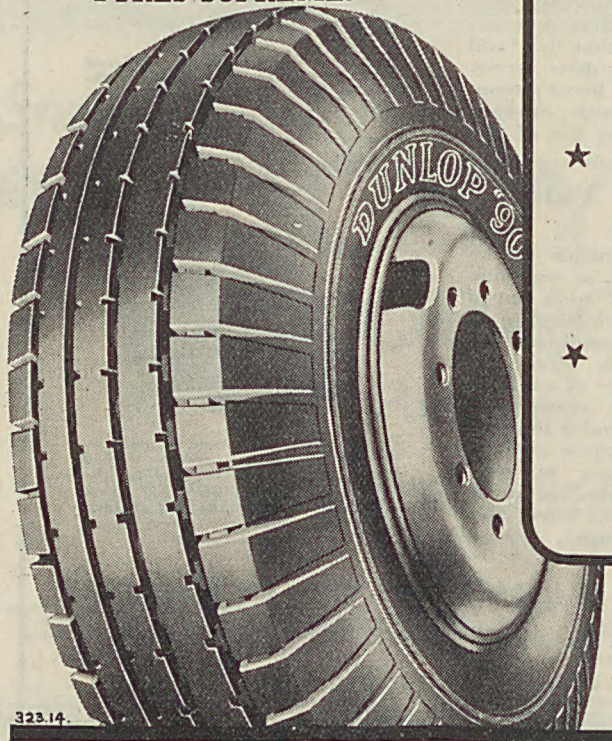
543-555 BOURKE STREET, MELBOURNE, C1

GE8A

The New DUNLOP GIANT 90 TRUCK TYRE

has definitely superseded all tyres for commercial vehicles

★ **THREE UNIQUE FEATURES MAKE THESE DUNLOP "90" TYRES SUPREME.**



323.14.

★ **THE FAMOUS "90" TREAD**— A greater depth of "tough compound" rubber for at least 15% more mileage—proved by tests on overloaded trucks . . . "Flat," full-width road-contact of five-rib pattern for maximum grip and safety.

★ **WEFTLESS CORD CONSTRUCTION**— Eliminates the destructive heat which saps life of ordinary casings. Weftless Cord gives 12% cooler running and 52% longer casing life.

★ **"DISC DOUBLING" OF CORDS**— An exclusive Dunlop process . . . giving more twist for greater elasticity . . . ensuring uniformity in every cord . . . allowing the casing to flex under heaviest load without injury or fatigue.

HAVE NO TRUCK WITH INFERIOR TYRES—

FIT DUNLOP "90"

QUALITY SEEDS

At Right Prices . . . .

Buy from the firm that guarantees quality in seeds, right prices, and prompt service. Mr. Wilson, Vesper, Victoria, writes: "*I believe every seed grew. I am satisfied about G. & N. seed—it is the very best quality on the market.*"

SPECIALLY REDUCED PRICES

Quoted for large quantities. When writing mention approximate amounts and get lowest quote. Seed samples for testing also available.

WE PAY FREIGHT FOR CASH ALL VICT. ORDERS OVER £2

G. & N. are Australia's Largest Suppliers

GUARANTEED GENUINE

GOVT. CERTIFIED SEEDS

The highest grade seed—unsurpassed in quality, purity, and germination—is Government Certified Seeds. With each variety go a certificate and a Departmental Seal. The only seed possessing a trueness-to-type. The absolute best for permanent pastures.

Clunes Certified Rye Grass "Permanent Pasture" Seed.

Colac Certified Rye Grass.

"Dwalganup" Sub. Clover, W.A. Certified (Extra Early).

Cocksfoot, N.Z. "Akaroa" and N.Z. "Mother Seed."

Phalaris, Tuberosa, N.S.W. Govt. Certified.

Phalaris, Tuberosa, S.A. Govt. Certified.

Plant SUMMER FODDERS Now!

Get ready for the days when green fodder is scarce. Select from this recommended range of drought-resisting quick-growing fodders. G. & N. Pedigree Seeds pay more because they yield more. Guaranteed free from weeds. G. & N. are leaders for—

LUCERNE
The farmer's No. 1 crop.

RAPE
The great Sheep Fodder.

KALE
Fattens sheep year round.

JAP. MILLET
The Dairyman's Summer Crop.

SOUDAN GRASS
Greatest drought-resister grown.

SORGHUMS
Sweetest Summer Fodders.

PRICE LIST OF ALL FARM SEEDS GLADLY SUPPLIED

GIPPSLAND & NORTHERN CO-OP. Co. Ltd.

Seed Department,
492-4 FLINDERS LANE, MELBOURNE, C.1
Telephone: Cent. 9140 (10 lines) Telegrams: "Gippsnorth," Seed Dept.

FREE

Seeding Bulletin

Contains tips and topics on Spring sowing. Every farmer needs it. Write to-day!

COMMONWEALTH DEPARTMENT OF HEALTH

PREVENTION OF ENTERO-TOXAEMIA

("PULPY KIDNEY")

in SHEEP and LAMBS

Do your stock suffer from this disease? Adopt measures to control it by using the

"COMMONWEALTH"

ENTERO-TOXAEMIA VACCINE

This vaccine has been given an extended trial throughout Australia with highly satisfactory results. It is used for the prevention and not the treatment of the disease.

It is available to Stockowners in a large range of containers suitable for inoculation of both small and large flocks.

A preventive treatment consists of two doses, the second of which is administered four weeks after the first.

This "COMMONWEALTH" Vaccine is available only direct from the Commonwealth Serum Laboratories, Parkville, Victoria, as it should be used in as fresh a condition as possible. The vaccine will be despatched within 24 hours of the receipt of an order.

Prices and full particulars on application.

Containers will be forwarded per train or post as desired immediately on receipt of order. Freight or postage extra.

The vaccine is obtainable from the

COMMONWEALTH SERUM LABORATORIES

PARKVILLE, N.2, VIC.

NATIONAL MUSEUM OF VICTORIA

The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

Subterranean Clover—Strains

By J. E. Harrison, B.Agr.Sc., Agrostological Research Officer

IN the last decade, the value of strain in a pasture species has received both scientific and general recognition. A strain of a species is a more subtle thing than a variety and more easily escapes detection. A variety always possesses an external variation such as a difference in the colour of its petals or fruit, or in the structure of its leaves or branches, which makes it readily distinguishable from the species type. A strain, however, has characters such as long or short life, leafiness or stemminess, high or low production, which become apparent only in comparative field tests. In both variety and strain, the distinguishing characteristics are heritable.

It will be apparent that strain differences are of importance in agriculture. In 1927, when attention was being directed in other parts of the world to the occurrence of strains in pasture species, an investigation into subterranean clover was begun at the Burnley Pasture Plant Research Station. With the co-operation of other State Departments of Agriculture, a few samples of seed were collected, under widely different climatic and soil conditions, from each State of the Commonwealth, except Queensland, where the clover is not established. These samples were used to establish plots of single plants, in which several strains were recognized. The differences were sufficiently outstanding and promising to warrant an extension of the work, and in the following season further collections of seed were made, more particularly within Victoria itself, from fields where the clover had appeared voluntarily and spread by natural means.

The results of the year's work were very satisfactory, for by the end of the season, over 40 distinct strains of the clover had been recognized and isolated. The more promising of these have since been under observation each year, seed has been distributed to other Research Stations and elsewhere, and an accumulation of data about each strain and its prospects as a pasture plant has taken place.

During the years since 1927, several strains have been grown regularly at Burnley, without indication of any loss of type. Further, when grown in any other district these strains have preserved their individual characteristics. Each succeeding generation is similar to the last, and the type remains fixed and normally unchangeable in nature. Though the strains have been grown alongside each other for several years, there has been no evidence of inter-pollination: insects have not been observed visiting the small flowers at any time; the keel of the flower, enclosing the sex organs, remains closed; self-pollination takes place and the essential characters of the parent are transmitted to its offspring.

These variations, called strains, result in the species having adaptation over a very wide range of winter rainfall. If the species were comprised of one strain only, with fixed characters of growth, time of flowering and setting of seed, it would suffer a restriction of habitat to a rainfall and length of growing season which suited it with some exactness, but, being comprised of a number of strains, differing from each other in these characters, the species has a wider range, from moderate to heavy rainfall, and from a brief growing season to a long one.

If grown in the same habitat, the strains behave differently from each other, according to their adaptation to the prevailing conditions. If the

winter rainfall is moderate and the growing season is brief, the early strains grow best, and the late strains encounter difficulties late in the season which may result in their death without seed having been set. This is readily understood, but it is not well recognized that if the winter rainfall is heavy and the growing season is long, then an early strain meets with troubles which may reduce its normal growth significantly and bring about its practical extinction. For example, it may be more susceptible to disease; or it may encounter cold weather at a time when its normal habit demands rising temperatures and more sunshine. Again, it may suffer severely from the competition of other species with better adaptation to a long season of growth; and finally, having set its seed early in spring, the seed may germinate in late spring and the seedlings may perish during the dry summer months.

This adaptation of the strains to different climatic conditions is exemplified by the results of trials at the Waite Institute, Adelaide, South Australia; at the Burnley Gardens, Melbourne, Victoria; and at the Plant Research Bureau, Palmerston North, New Zealand. Trials at these three stations illustrate very well the behaviour of the strains under moderate, good, and heavy rainfall, with a progressive increase in the lengths of the growing seasons as the rainfall increases. At the Waite Institute, the early strains are productive and persistent from year to year, and later strains fail to set seed and so die out. At Burnley Gardens, the midseason and somewhat later strains show most adaptation, according to the season; the early strains make low production in the first year, and develop reduced swards in the next and following years. At the New Zealand station, with a heavy rainfall and long growing season, the late strains are outstanding in their total production for the year; the midseason strains perform only fairly; and the early strains are relatively very low producers.

It is interesting to note in some issued reports that investigators would prefer a somewhat different strain from that which shows greatest adaptation in their trials. The desire is to grow either a more productive strain where only an early one persists, or one which makes greater winter and early spring growth where a late strain is normally most adapted to the climatic and soil conditions. It will be interesting to learn what success is achieved in practice in these directions as time goes on.

Within Victoria, the adaptation of a strain to a particular set of conditions has usually been manifest. When seed was collected from various Victorian districts and the resultant plants were classified, a fairly close relation was discovered between the character of the strains, and the rainfall and the length of the growing season

Early strains of subterranean clover. Note the earlier runner development in the Dwalganup (left), strain and the greater leafiness of Mulwala (right).

Subterranean clover tests in the Burnley Plant Research Field.

which usually prevail in the districts from which the strains came. The early strains came from districts of light to moderate rainfall, and the late strains from districts of relatively good rainfall. But the average annual rainfall is not an exact guide to the adaptation of a strain, as the distribution of rain throughout the year, especially during the spring months, is also important.

Further in any district various soil factors determine the value of the rain that falls to the plants growing in that soil. There is for example usually a considerable run-off of water from a hillside, which results in less water being available there and in a greater amount being available on adjacent flat land. Again, a porous soil may readily absorb all rain that falls and thus be more favorable than a hard, heavy, and impermeable soil for the growth of a later strain. Under a relatively heavy rainfall, a sandy soil may, on the other hand, dry out rapidly in spring and fail to support a late strain as well as a heavy soil in the same district.

If these qualifications are borne in mind, the general statement is possible that the different strains of subterranean clover each find adaptation to those districts where the length of the growing season, as determined by the rainfall, conforms to their respective periods of growth.

In classifying the strains, it has been found convenient to divide them into groups according to the time of the year when they normally begin to flower and set seed. The readiest classification is one of three groups, viz.: Early, midseason, and late strains, and actually a subdivision into seven groups, viz.: Very early, early, early midseason, midseason, late midseason, late, and very late, affords a very much better appreciation of the gradations in the time of flowering, but it is unlikely that such a subdivision of commercial strains will be necessary for several years to come.

A comparison of the average characters of early, midseason, and late strains will serve to inform farmers of the general nature of these groups.

Early Strains.

Early strains have long primary runners with one or two lateral branches only. The leaves are spaced well apart along the runners and a single plant looks sparsely leaved, with a high proportion of stem. The leaves have long stalks, and a sward of an early strain has the appearance of making better growth than other strains in autumn and winter. It is doubtful whether this is so, or at least whether the extra growth is of much importance, until actual runner development begins. Since the flowers arise from the runners, early flowering implies early runner development, and as rapid growth begins with the formation of runners, early strains make quicker growth than other strains in early spring.

When all strains are grown at the one place, under a rainfall adequate for the full development of them all, early strains produce the lowest total bulk of fodder. They are heavy seeders nevertheless, but having long flower stalks, and setting their seed when the soil is usually moist, they tend to bury their burrs deeply, even to a depth of two inches.

Left.—Note the advanced runner development of the Dwalganup (early) strain. Centre.—Runner development beginning in the Mt. Barker (midseason) strain. Right, Tallarook subterranean clover. Note leafiness and that runner development has not yet begun.

Dwa'ganup is a *very* early strain which has been developed commercially in Western Australia. Genuine seed of this strain is certified in sealed sacks by the Department of Agriculture in that State, and may be obtained in large quantities from the usual commercial sources.

Plants of this strain are characterized by long, sparsely-leaved runners. Flowering usually begins, at Burnley, about mid-August, but if seed should germinate in December or January, with the occurrence of summer rains, the resultant plants may flower before the following winter. The leaves are dark green, with white marking and black flecks, while the runners are of a reddish colour. The calyx of the floret is green, with pale red tips, and the corolla is pink.

Though this strain has been grown satisfactorily in sandy soil at Noradjuha, near Horsham, in the southern Wimmera, with an annual rainfall of about 19 inches, it has not given satisfaction in other districts. It is the most extreme strain of its group, and the gap between the common mid-season strain and the very early Dwalganup is so wide as to suggest that one of the less extreme early strains, like Bacchus Marsh, is more likely to fill the need of an early maturing plant in our districts of less moderate rainfall (under 21 inches) and a short growing season.

Mulwala, another very early strain, was discovered growing at Mulwala in New South Wales, across the Murray River from Cobram. A small harvest was made this season (1937) and it is understood that preparation is being made for a larger harvest next season.

The strain normally flowers a few days later than Dwalganup and, though it has the typical characters of a very early strain, it is somewhat leafier and more attractive in appearance than Dwalganup and grows later into the spring. The leaves are larger and a lighter green colour, but otherwise the two strains have very similar vegetative and botanical characters.

At Mulwala, where the average rainfall is 18 inches annually, the common midseason strain (Mt. Barker) has been sown down and failed to persist, and under similar conditions the Mulwala strain has prospects of usefulness.

Bacchus Marsh is an early strain which has been isolated from fields of clover which have spread by natural means at Myrniong, in the Bacchus Marsh district. The plant has long runners, is fairly leafy, and the leaves are larger and a lighter green than those of the strains above. This strain has been the subject of favorable comment by several Plant Research Stations and has behaved well and consistently in the Burnley field for several years. It is selected as the most promising of the early strains, and efforts are being made to arrange for a harvest of certified seed.

Flowering normally begins at Burnley in early September. The calyx of the floret is pale green and the corolla is white. In favorable seasons, autumn growth and early spring growth are very good. Runner formation is rapid and a good sward may be formed in the second year.

Though tending more towards the midseason strains, its characters may be described as intermediate between those of the very early and the

midseason strains. It thus seems a very suitable plant for establishment in the drier belt of country immediately beyond the districts of moderate rainfall (over 21 inches) where the midseason strain (Mt. Barker) is now growing.

Midseason Strains.

Midseason strains lie midway between the early and the late strains in regard to leafiness and length of primary runners, which usually have five or six lateral branches. The leaves are spaced fairly well apart along the runners, and a single plant looks fairly leafy, with a moderate proportion of stem. A good sward of midseason subterranean clover is dense and makes satisfactory growth in both autumn and early spring under favorable conditions.

Midseason strains are usually heavy seeders and bury their burrs freely. Under rainfall conditions adequate for the three main types, the midseason strains are more productive than early strains and less productive than late strains.

Mt. Barker is a midseason strain which forms the great bulk of the seed of commerce. It derives its name from Mt. Barker, in South Australia, where the seed industry first developed and where the largest quantity of subterranean clover seed is still grown. Seed of the same strain is extensively harvested in Western Australia, Victoria, and Tasmania also, and is usually referred to as "Midseason strain." A satisfactory certification scheme has been inaugurated by the Tasmanian Department of Agriculture in respect of seed of this strain.

The Mt. Barker strain, in a normal season, begins flowering at Burnley about mid-September. The calyx of the floret is green, with a red or bright red band, and the corolla is white. The plant is leafy, with fairly long runners. The leaves are green, with white crescent and black flecks. In favorable seasons, both autumn and spring growth are very good; runner formation is rapid and seed is set plentifully. A good sward, fairly dense and productive, may be formed in the second year.

This strain has proved itself of outstanding merit in all districts where favorable rains fall from April to November. It has grown satisfactorily also in areas with a somewhat lower rainfall than is generally looked upon as necessary,

Showing root development in three strains of subterranean clover. From left to right—Dwalganup (early), Mt. Barker (midseason), Tallarook (late). Note the increasingly complex root systems of later strains.

and it seems desirable always to try this strain before deciding that only a very early one, like Dwalganup, has a chance of success.

Late Strains.

Late strains are in marked contrast to both the above groups. They have relatively short primary runners, with ten or more lateral branches. Leaves are numerous, and even a single plant forms a dense compact mat of clover, with a high proportion of leaf to stem. Plants remain in the rosette stage longer, and form runners later in the spring, than other strains. They are mostly heavy seeders, and bury only a small proportion of their burr as a rule. Under adequate rainfall, they produce a greater bulk of fodder than the strains of other groups.

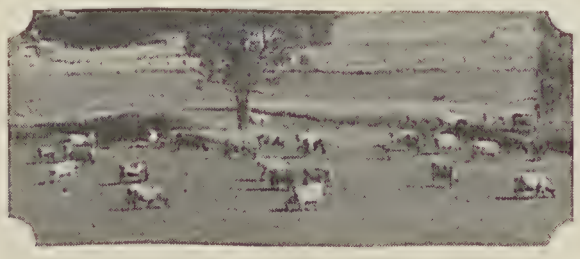
Tallarook is a late strain which has been developed in Victoria and is named after the district where it was first found growing. Seed is certified by the Victorian Department of Agriculture and is obtainable from the usual commercial sources. The plant is densely leaved and has relatively short runners, with numerous secondary branches. The leaves are fairly large, with white crescent and black flecks, and during winter the lower part of each leaflet beneath the white crescent may turn a dark brown colour. The calyx of the floret is pale green and the corolla is white.

The plant remains in the rosette stage, and continues to make basal leaves, over a longer period than any of the above strains. It thus begins rapid growth later in spring. Its autumn growth, under favorable conditions, equals that of other strains and because of its long period of growth in spring it may be green for ten months of the year.

At Tallarook, where the average rainfall is 24 inches annually, the clover is restricted mainly to the moist and fertile river flats. It is known to grow well in the central highlands of Victoria, where the rainfall is high (over 30 inches) and the spring extends into December, and it has been sown down in districts of good rainfall (27 inches or more) in north-eastern and southern Victoria with marked success. Its long, green life and high production fit it for districts of good rainfall and long springs; and it is expected that its use will extend.

These descriptions of the various strains are intended as no more than a guide to their general character and nature, and to their suitability for different districts. Other factors may influence their use, such as a need for quicker growth in early spring, which would involve the use of an earlier strain than the one normally adapted to a district; or it may be desirable to employ two different strains for early land and late land on the same farm. It is not recommended that the strains should be mixed, as one tends always to overshadow the other and prevent it from exhibiting its normal habit of growth. A better result will be obtained, and a strain will make its growth at its characteristic period, if it is the only strain sown in a field.

It is necessary to warn intending purchasers of subterranean clover always to specify the strain that they need. If only "subterranean clover" seed is ordered, it is usually understood to mean the midseason strain, but this is not always supplied and there is no obligation on the part of vendors to supply it. Wherever possible, a purchaser is wise to take advantage of the certification schemes which have been instituted by the various Departments of Agriculture, and to order only certified seed of the strain he requires.



Insect Pests of Subterranean Clover

By R. T. M. Pescott, M.Agr.Sc., Entomologist

IN Victoria, there are a number of insects which may be classed as pests of subterranean clover, but of these, only four may be considered as serious. They are—

(i) Lucerne Flea (*Sminthurus viridis* L.),

(ii) The Red Legged Earth Mite (*Halotydeus destructor* Jack.) and the Pea Mite (*Penthaleus major Duges*),

(iii) Cockchafers (family Scarabaeidae).

Other insects which are occasionally or spasmodically found attacking subterranean clover include Cutworms, Crickets, Grasshoppers, &c.

Of these four major pests, three, viz., the Red Legged Earth Mite, the Pea Mite, and the Cockchafers are pests which normally do not have any direct relation to the sowing down of new areas with subterranean clover. With Lucerne Flea, however, there is definite evidence available to show that the more recent outbreaks of this pest in Victoria have followed within a few years of the sowing down of subterranean clover with seed from a district where lucerne flea abounds. The reason for this is that the eggs of lucerne flea may be present in the soil particles which generally are present to some extent in a sample of subterranean clover seed (see Figure 1).

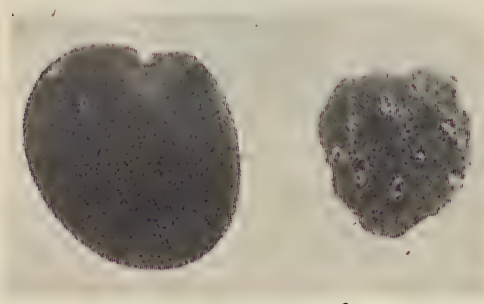


Fig. 1.—Seed of subterranean clover and eggs of lucerne flea in nodule of earth.
[After Nicholls.

Fig. 2.—Lucerne flea damage on clover leaves.
[After Nicholls.

The Lucerne Flea (*Sminthurus viridis L.*).

The lucerne flea, which is an introduced insect, was, until several years ago, confined to the coastal areas of the central and western portions of the Western District. More recently, however, it has been found scattered over other portions of the State, including both dry country and irrigation areas.

This insect feeds on quite a variety of food plants, the chief of which among economic plants are subterranean clover, lucerne, and burr clover (*Medicago denticulata*). Pasture grasses are occasionally attacked, but only when grown in association with subterranean clover. The insects feed on the foliage of the clover, eating out the green tissue (see Figure 2), either completely or in small areas of the leaf producing a generally withered appearance over large areas of pasture. Particularly early in the season and in periods of heavy infestation, the growth of subterranean clover may be seriously inhibited, although it is doubtful whether actual death of plants ever results. With the more rapid growth of subterranean clover in the spring, the plant is usually

More Acres PER DAY! Less fuel! Less fatigue!

Goodyear, the pioneer of tractor tyres in Australia, now offers farmers the finest tractor tyre yet developed—the only tyre with maximum grip and pulling power forwards, backwards and sideways.

This outstanding advantage of the new Goodyear All-Way-Traction Tractor Tyre results in greater fuel savings than ever before possible. plus 30% greater drawbar pull, faster and better tractor work—with 50% more traction and 100% more shoulder grip!

GOODYEAR-IZE YOUR FARM

There's the right Goodyear Belt for all your stationary work. There's the right Goodyear Tyre for your car, your truck, and your farm machinery, for instance—

BINDER—COMBINE—MOWER—SPRAYER—FARM WAGGONS—HAY PRESS—HEADER—CULTIVATOR—THRESHER.

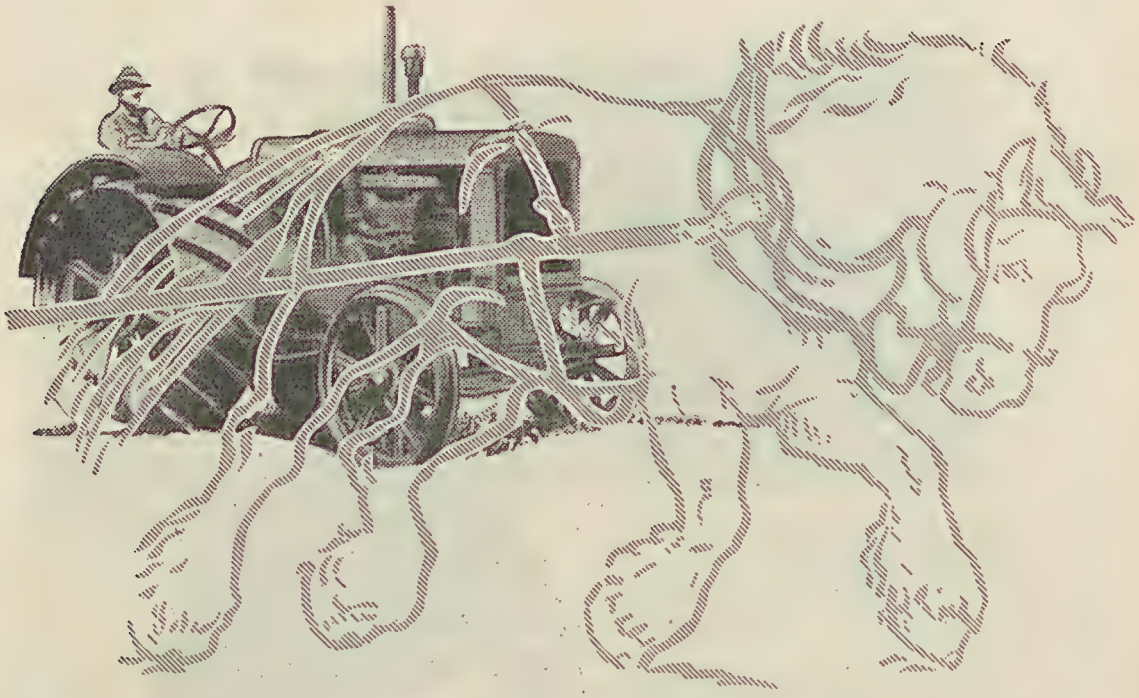
THE NEW GOODYEAR ALL-WAY-TRACTION TRACTOR TYRE

TERMS!
Goodyear Tractor Tyres and Wheels are available on Hire Purchase Terms. For particulars write the Goodyear Branch (all capital cities).

SEND FOR INTERESTING LITERATURE
on the advantages of pneumatic tyres for tractors and farm machinery.
Goodyear Tyre and Rubber Co., 23 Therry St., Melbourne.

Name & Address..... .....

.... AM 87



Is yours a Grass-fed Tractor?

Everybody knows that a grass-fed horse has NOT the same pulling power and stamina as a horse that is fed the proper food . . . and so a tractor must be fed with a power kerosene, HIGH in anti-knock quality (its proper food) to get maximum pulling power.

HIGH ANTI-KNOCK ensures the FULL power output your tractor was built to give. . . . AND BECAUSE Voco Power Kerosene has the highest anti-knock rating of all power kerosenes you buy, it is your logical choice for Maximum Power and the greatest possible Economy. When Mobiloil, the World's Quality Tractor Oil, is used in conjunction, you have an unbeatable combination for Power and full Protection.

VOCO *Power* **KEROSENE**

Biological Control.—During 1931, in Western Australia, a parasitic Bdellid mite, *Biscirus lapidarius* Kramer, was observed feeding actively on lucerne fleas (see Figure 5), and, in some areas, had so reduced their population that very little damage, if any, was apparent to pastures. In 1933 several consignments of these mites were received from Western Australia and liberated in lucerne flea affected areas in the Western District of Victoria, while in 1936 further supplies

Fig. 5.—Bdellid mites feeding on lucerne flea.
[After C.S.I.R.

were received and liberated in other parts of Victoria. An inspection of those areas where the mites were liberated in 1933 has shown that they have survived, and are now multiplying to such numbers that it can be expected that they will produce a very definite reduction in the lucerne flea population in those areas.

It has been found also, on inspection, that this mite has appeared naturally in several different districts in Victoria, and, in one of these particularly, viz., Tatura, has exercised a very satisfactory control of lucerne flea. It is proposed shortly to make transfers of large numbers of these mites to those districts where the mite is not at the present time apparent.

Growers who are desirous of obtaining supplies of this parasitic mite are advised to communicate with the Department of Agriculture on the matter.

Spraying Control.—Spraying experiments in South Australia (2) have shown that, by the judicious use of lime sulphur as a spray, the number of lucerne fleas in a paddock can be reduced to such an extent that damage is considerably reduced. This is accomplished by—

(i) closely grazing the pasture three or four weeks after the oversummering eggs of lucerne flea have commenced to hatch in the autumn, and then spraying thoroughly with lime sulphur at a strength of 1 in 60, using 80 gallons of spray per acre, and applied at a pressure of at least 200 lb. per square inch, and

(ii) following this up with further sprayings of the same material, the number of such sprayings to depend on the degree of infestation of the crop. In all cases, the crop should be closely grazed down, before attempting spraying.

It must be realized that by this method it is not possible to eradicate the pest, but it is usually an annual procedure whereby losses due to lucerne flea may be minimized.

The Red Legged Earth Mite and the Pea Mite.

The Red Legged Earth Mite and the Pea Mite, collectively spoken of by farmers as red spiders, are very widespread in their distribution throughout Victoria. They are undoubtedly serious pests of pastures, attacking primarily the clovers, particularly subterranean clover. They are also commonly found in association with cape weed.

The mouth parts of these mites are developed more for rasping than for piercing. The surface of the leaf is broken and the sap sucked (see Figure 7). This results in a silvery or bleached area on the plant attacked, and where the mites are numerous and the bleached areas large, plants, and particularly young ones, cannot stand up to the loss of sap, and consequently die. Once the plant is making strong growth, however, the mites do not appear to do severe damage. The most severe general damage probably is done when the mites are working over large areas of pasture early in the season. Growers rely to a great extent on early winter feed from pastures, but,

Fig. 6—The Red Legged Earth Mite (adult female).
Left.—Dorsal view. Right.—Ventral view. Magnified by 20.

where the mite is in large numbers, this early growth may be checked entirely with the consequent loss of the early winter feed. Later, however, providing the plants have withstood the early attack, they grow away from this trouble, and good late crops result.

Like the lucerne flea, the mites make their appearance early in autumn, shortly after the autumn rains. At that time eggs, which were laid towards the end of November, commence to hatch out, and myriads of small six-legged mites are to be found. The summer eggs are laid by the thousands about the surface of the soil, under clods, dry weeds, or rubbish. These eggs are extremely resistant to heat, drought, and drying winds, although some are always destroyed under these conditions.

In the adult stage, the mites measure about one-twenty-fifth of an inch in length, with the body of a dense velvety black colour, and with eight red legs. They are capable of very rapid motion over the ground. There are several generations or broods in a year.

Control Measures.

Control measures should aim at making conditions so unsuitable for the mites that they are unable to exist in any numbers, thus allowing the young plants to become thoroughly established.

In the preparation of a field for a subterranean closer pasture, in order to minimize the effects of mites, fallowing is very helpful. It takes three or four years for the insects to reach numbers in which they will do severe damage after a paddock has been first infested. After plowing, the ground should be worked down to a fine tilth, and any subsequent growth of weeds and clovers on the fallow kept suppressed. Clean fallow during the early spring and summer will guarantee freedom from the pest at the time of sowing. Any later trouble can come only from an invasion from outside areas. This can be checked by a chemical method.

Fig. 7.—Leaf showing typical injury caused by mite.
[W.A. Department of Agric.

A method which has been used very successfully by some farmers, e.g., in the Bacchus Marsh and Murchison districts, is to place a "ring" of creosote right around the fence of the paddock to be sown down. This consists of a narrow strip (about 3 inches wide) of creosote, which is produced by partially flattening the end of the spout of a watering-can containing the creosote. It is found that, providing the "ring" remains unbroken, the mites will not cross it for a period ranging from four to six weeks. Thus any possible reinfestation from outside is prevented. It thus becomes necessary, then, to destroy those mites that are enclosed in the field to prevent their breeding up in large numbers. This can be accomplished by using the following method:—

A suitable powder can be prepared by mixing together thoroughly one part (by weight) of 15 per cent. carbolic powder and four parts of superphosphate. This should be broadcast by hand over the affected area, or, in the case of large pastures, spread out with an ordinary farm drill or artificial manure spreader. To be effective, 1 to 1½ cwt. per acre should be applied. This material serves a double purpose. The manure in the above material, while acting as a spreader for the carbolic powder (which actually destroys the mites) stimulates plant growth, thus increasing the resistance of the plant to attack. If, for any reason, the use of superphosphate is not desirable, ordinary fine sand can be used as a filler for the carbolic powder.

The dust should be applied between 11 a.m. and sundown on warm days. The mite does not become active until the foliage has become dry, and, if the dust is applied to wet foliage, the greater part of its effectiveness is lost, owing to its caking on the leaves. To obtain the maximum results, the mixture should be applied to the plants about a fortnight after the main autumn rains, so as to kill the young mites before they have time to do any serious damage.

Cockchafers.

With the widespread inclusion of subterranean clover in pastures and the use of superphosphate to increase the growth of such pastures, there has been a very definite increase in the population

of cockchafers in pastures. Cockchafers, or white grubs, as they are commonly called, are very definite in appearance (see Figure 8). They are relatively stout, with a long wrinkled body of a whitish or creamish colour. When disturbed they curl up into a crescent shape, the end of the body being swollen and dark, owing to the presence of food in the body. They appear sluggish, but by means of their strong legs are readily able to work their way through the soil.

In Victoria, cockchafer trouble appears to be most severe in the Western District pastures where the most common species is *Aphodius tasmaniae* Hope. With this species, the larvae or grubs live in a tunnel in the soil during the day, emerging at night time when they move about freely over the surface. Portions of clover leaves are cut off, and carried sown into the tunnel for consumption later. The soil that is excavated in making the burrows is spread in a crumply pile at the mouth of the burrows.

In areas where the degree of infestation of the pasture is high, as many as 150 burrows per square foot being recorded in South Australia (3), a large amount of soil may be thrown out of the burrows, in some cases sufficient to cover the young growth of pasture. If this occurs in winter, when the growth of pastures may be slow, it frequently happens that the pasture dies out with the resultant formation of a bare patch.

Control Measures.

The control of cockchafer grubs in pastures is a most difficult problem, owing to the usually widespread nature of the infestation, the habit of the grubs in working underground for portion of its life and the fact that arsenical preparations cannot be used normally on pastures. Thus, over large areas of pastures, it is not possible to recommend any conclusive method of control.

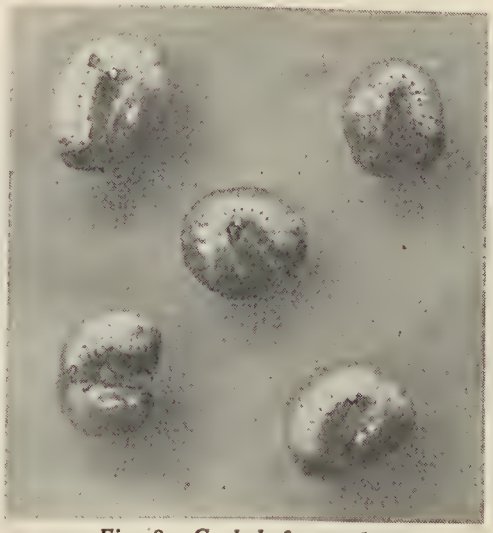


Fig. 8.—Cockchafer grubs.

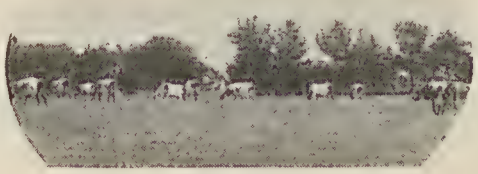
If, however, a small area of infection is found in a valuable pasture, it would certainly be a proposition to fence off this affected portion, and spray the pasture with arsenate of lead, using 5 lb. of arsenate of lead paste to every 100 gallons of water. Some time should elapse before this treated portion of the pasture is thrown open to grazing.

References.

(1) Nicholls, H. M.—How the Lucerne Flea is Introduced, Tas. Journal of Agriculture, vol. III., part 2, p. 68, 1932.

(2) Davidson, J.—On the Control of the Lucerne Flea (*Smĭnthurus viridis* L.) in Lucerne in South Australia, S.A. Journal of Agric., XXXVI., No. 9, pp. 994–1006, 1933.

(3) Swan, D. C.—A Scarab Beetle, S.A. Journal of Agric., XXXVII., No. 9, pp. 1149–1156, 1934.



Chicken Feeding Test

Chick Mixture v. Soaked Grain

W. O. Pederick and A. G. Clark.

AT the close of the 1936 chicken season, at the request of the Victorian Branch of the National Utility Poultry Breeders Association of Australia, the soaked wheat system of feeding was tested against the Werribee chick mixture which has been used at the State Research Farm, Werribee, for many years.

Sixty chickens were used for the test. These were divided into two groups, each containing 30 chickens. Group 1 comprised 15 white leghorns, and 15 australorps which were fed on the Werribee chick mixture, and group 2 also contained 15 white leghorns and 15 australorps, which were fed on a soaked wheat ration.

The chickens were hatched on 19th October. The test commenced on 1st November, when the chicks were a fortnight old, and concluded on 31st January—a period of three months. It was intended to commence this test when the chicks were younger, but it was found that they would not eat the soaked wheat until they were a fortnight old.

The methods of feeding were as follow:—

Group 1.—"The Werribee Chick Mixture" consists of maize meal 80 parts (by weight), wheatmeal 40 parts, crushed hulled oats 20 parts, bran 20 parts, dried buttermilk 20 parts, charcoal 6 parts, shellgrit 5 parts, bonemeal 5 parts, salt 1 part, and dicalcic phosphate 1 part. This mixture was available to the chicks at all times as a dry mash, and the same mixture was also fed as a wet mash two to three times a day. From 16th December to the conclusion of the test a small amount of wheat was given once a day as a scratch grain.

Group 2.—"The soaked wheat system." (The wheat was soaked for 24 hours and the other ingredients added just before feeding). The mixture, which consisted of wheat 100 parts (by weight before soaking), meatmeal 10 parts, linseed meal 5 parts, bran 7½ parts, and bonemeal 1 part, was fed four times a day at regular intervals. The chicks were allowed as much as they would eat at each feed time. Shell grit and charcoal were also provided.

In both groups the chickens had access to a green rye-grass run and a liberal supply of green-feed was fed in addition.

Tables I. and II. show the amount of food consumed in each group, the cost of the food (based on the retail price), and the weight of the chicks at different periods.

TABLE I.

Date.	Weight of Chicks.
Group 1.—*Werribee Chick Mixture.*	
Nov. 1st ..	4 lb. 1 oz. (30 chicks)
Dec. 1st ..	18 lb. 12 oz. (30 chicks)
Jan. 1st ..	60 lb. 10 oz. (30 chicks)
Jan. 31st ..	95 lb. 3 oz. (30 chicks)
Jan. 31st ..	Average weight per chick 3lb. 2.8 oz.
Group 2.—*Soaked Grain.*	
Nov. 1st ..	4 lb. 3 oz. (30 chicks)
Dec. 1st ..	16 lb. 5 oz. (29 chicks)
Jan. 1st ..	45 lb. 8 oz. (29 chicks)
Jan. 31st ..	72 lb. 13 oz. (29 chicks)
Jan. 31st ..	Average weight per chick 2 lb. 8.2 oz.

TABLE II.

Total Food Consumed.	Food Consumed per Chick.	Total Cost of Food.	Food Cost per Chick.
	lb. oz.	£ s. d.	s. d.
Werribee chick mixture, 349 lb. 6 oz. ..	11 10·3	2 1 3	1 4¼
Soaked grain. 335 lb. 5¼ oz.	11 9	1 13 1	1 1·7

[*Continued on page* 416.

Codling Moth and Black Spot Control

Apple and Pear Demonstration Plots, 1936-37

Rome Beauty apple trees on the property of Mr. G. W. Brown, Red Hill.

THE Department of Agriculture last year established a series of demonstration plots in all the principal apple and pear growing districts of Victoria. The object of these plots, which were situated on commercial orchards, was to demonstrate to the growers, in a practical manner, the departmental recommendations for the control of Black Spot of Apples (*Venturia inaequalis*, Aderh.), and of Pears (*Venturia pirina*, Aderh.), and Codling Moth (*Carpocapsa pomonella, L.*) of both these fruits. The work was made possible by funds provided by the Commonwealth Government and the willing co-operation of the orchardists on whose properties the plots were located.

Prior to the undertaking of this work, it was considered that the control of Black Spot and Codling Moth was not as uniformly satisfactory as was consistent with the available knowledge, and the results obtained by efficient orchardists. In addition to being of direct benefit to the growers these plots also provided the Department with first hand information on the problems over a wide area, and enabled investigators to assess more efficiently the necessity for further work.

Plots were established on 25 orchards. In eighteen cases the plots were each approximately 3 acres in area, while seven were of approximately 1 acre each. The total area was 60 acres and comprised twelve varieties of apples and five varieties of pears. Ten of these plots were situated in the northern areas of the State and twelve in districts south of the Divide.

Past experimental work in the control of black spot and codling moth of apples and pears enabled spray schedules to be drawn up and the district orchard supervisors, who had charge of the plots, modified these as local conditions demanded. It was anticipated that by carefully timing sprays, control of codling moth could be achieved with from three to seven sprays according to the variety and district. These schedules were as follows:—

Apples.

SPRAY SCHEDULE "A".

1. Green Tip Stage — Bordeaux mixture 6 : 4 : 40 (6 lb. bluestone, 4 lb. quicklime, to 40 gallons water).
2. 5 to 10 per cent. Blossom (not later)—Lime sulphur 3 : 80.
3. 90 per cent. Petal Fall—Lime sulphur 2 : 80.
4. Late Calyx (before closing)—Lead arsenate paste 5 : 80 gallons (plus ½ lb. lime casein in 80).
5. Fourteen days after 90 per cent. Petal Fall (No. 3)—Lime sulphur 1½ : 80.
6. Ten to twelve days after No. 4—Lead arsenate paste 5 : 80 (plus ½ lb. lime casein).
7. Twelve to fourteen days after No. 6—Lead arsenate paste 5 : 80 (plus ½ lb. lime casein).

Further lead arsenate sprays were applied according to moth activity as shown by lures and other observations, such as the presence of codling moth eggs on the fruit. Lime sulphur and lead sprays were not mixed.

Spray Schedule "B".

1. Green Tip Stage—Bordeaux mixture 6 : 4 : 40.
2. 5 to 10 per cent. Blossom (not later)—Lime sulphur 3 : 80.
3. 80 per cent. Petal Fall—Lime sulphur 2 : 80.
4. Early Calyx 75 to 80 per cent. Petal Fall—Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80).
5. Late Calyx eight to ten days after No. 4—Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80).
6. Fourteen days after No. 3—Lime sulphur 1½ : 80.
7. Twelve to fourteen days after No. 5 according to lures, &c.—Lead arsenate 5 : 80 (plus ½ lb. lime casein).

In the summer sprays, lead arsenate was replaced by white oil 1 : 60 (plus ¼ lb. lime casein spreader) in an attempt to reduce the arsenical residue below the allowable limit of ·01 grains of arsenic trioxide (As_2O_3) per pound of fruit, at the same time remembering that spray injury may result if oil sprays are applied within three weeks of a lime sulphur spray. Where late spot was observed, 4 to 6 oz. of bluestone plus 4 or 6 oz. of freshly slaked lime was added to each 100 gallons of white oil mixture.

Apple Blossom—"Early pink" stage.

These two Schedules "A" and "B," while being the same for black spot control, provide alternate methods of combating codling moth.

A further spray schedule giving an alternate method of controlling black spot and codling moth was drawn up as follows:—

Spray Schedule "C".

1. Green Tip Stage—Bordeaux mixture 6 : 4 : 40.
2. Early Pink Stage—Bordeaux mixture 3 : 3 : 50.
3. Late Calyx Stage—Lead arsenate 5 lb. in 80 gallons.

Later spray applications were timed as in Schedule "A," using lead arsenate throughout.

Schedule "C" must *not* be used on the following varieties owing to the danger of russet:—Jonathan, London Pippin, Yates, Dunn's and Gravenstein. For late spot control—include 6 oz. bluestone and 6 oz. of freshly slaked lime in the late lead sprays, except on the above varieties.

Apple blossom buds showing "green tip" stage. The bud scales have separated and the tips of the young green leaves are exposed.

Pears.

A schedule consisting of Bordeaux mixture and lead arsenate sprays was adopted as follows:—

1. Green Tip Stage—Bordeaux mixture 6 : 4 : 40.
2. Finger Stage (before white petals show)—Bordeaux mixture 6 : 4 : 40.

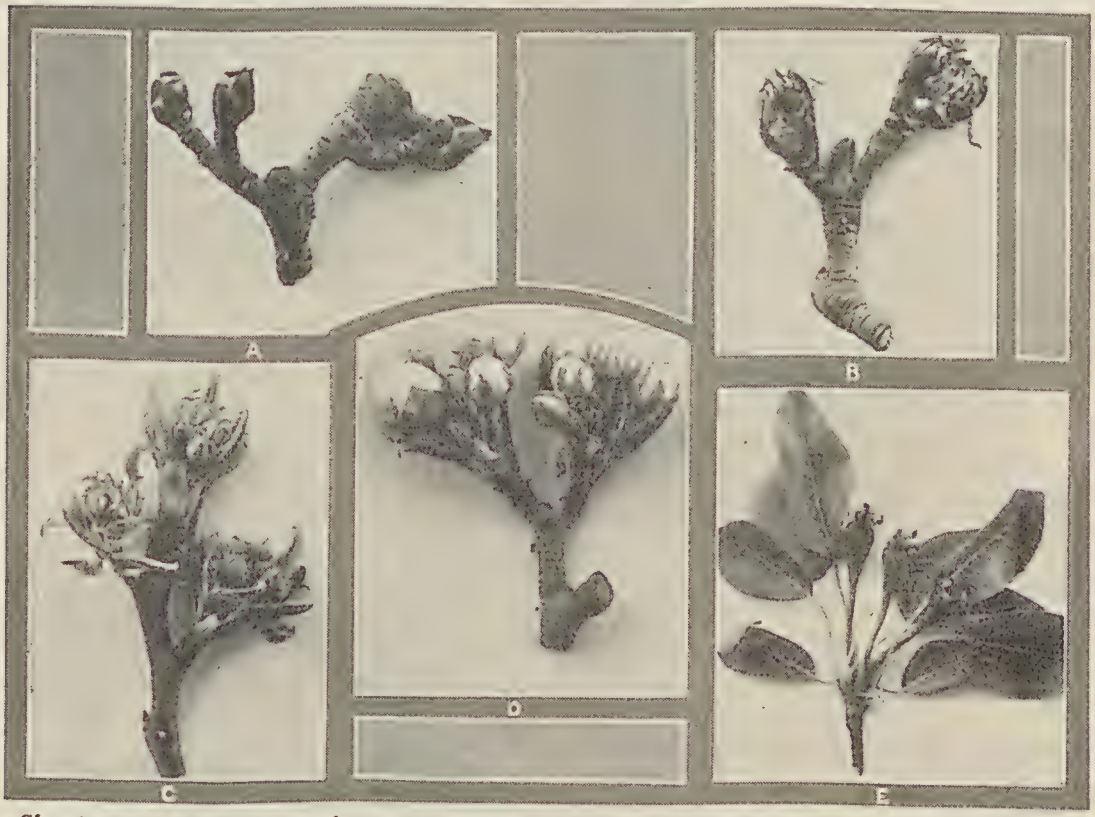
3. Late Calyx (before pears turn over)—Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80 gallons, plus Bordeaux mixture 3 : 3 : 50.
4. Twelve to fourteen days after No. 3—Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80 gallons).
5. Guided by lures, bands, &c. — Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80 gallons).
6. Guided by lures, bands, &c. — Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80 gallons).
7. Guided by lures, bands, &c. — Lead arsenate 5 : 80 (plus ½ lb. lime casein in 80 gallons).

(Spray No. 7 may not be necessary.)

This schedule was applied to all varieties except Josephine and Winter Nelis. To Josephine, only the green tip Bordeaux mixture spray can be applied, while to Winter Nelis the second Bordeaux mixture spray must be applied before any petals show pink, and the third should not be applied within three weeks of petal fall. A weaker, third spray of 1 : 1 : 50 Bordeaux mixture will reduce russet on Packham's Triumph and other clean-skinned varieties.

The timing of black spot sprays is by reference to the stage of the developing buds on the tree. The most important stage is *green tip*, which is recognized when the bud scales have separated and exposed the tips of the young green leaves just sufficiently to enable a penetrating spray to be applied. Pears are sprayed at a slightly later stage than apples.

On pears a spray of the same strength is repeated when the young unopened flowers in each bud have just separated, but before white petals show, i.e., at the *finger tip* stage.



Showing stages of bud development in relation to the application of sprays for the control of black spot of pears.

A. Buds swelling too early for 1st Bordeaux spray; B. *Green Tip Stage*—Apply 1st Bordeaux spray 6:4:40. [Note this spray may be delayed until at least 70 per cent. of the buds are in the stage shown by the right hand bud in B.]; C. *Finger Tip Stage*—Flower buds still green, separating in the cluster, but before white petals show; D. *White Bud Stage*—Too late for 2nd Bordeaux mixture; E. *About 3 weeks after setting*—Before young pears turn over.

It will be seen that for the control of black spot it is essential that the spray treatment should be preventive, rather than curative, and, for this purpose, the fungicidal properties of copper, in the form of Bordeaux mixture, and sulphur, as lime sulphur, have been employed. The correct timing of the application of each spray is essential both from the point of view of controlling the fungus and to minimize injury to the foliage and fruit.

For the control of codling moth, arsenate of lead and summer white oil sprays were employed, but also, particular attention was paid to the various supplementary measures such as the scraping of loose bark from the trees and props, and chemical banding, &c. As codling moth infestations in Victoria usually occur as two, more or less distinct, broods, one in the spring, and the other in the late summer, it was decided to direct control measures against these two broods with particular concentration on the spring brood. To enable the time of emergence of these broods, to be accurately obtained, lure pots of 10 per cent. vinegar solution in glass jars, were suspended in trees in the plots. More details of these lures are given below. To supplement the information obtained from these lures, observations were made of egg-laying and the entry of larvae into hessian bands during the season.

To effectively control the spring brood, one or two calyx sprays were applied, and then particular attention was given to the maintenance of a protective cover of arsenate of lead over the fruit during the vital period following egg-hatching.

TABLE I.—LURE-POT RECORDS—SOUTHERN DISTRICTS.

District.	Number of Lures.	Total Number of Moths Caught.	Number of Moths per Lure-Pot.
APPLE PLOTS.			
Drouin	24	842	35·0
Pakenham ..	36	114	3·3
Tyabb	26	190	7·3
Red Hill	32	622	18·0
Wantirna	26	539	21·0
Croydon	26	1,247	48·0
Wallington ..	24	366	15·3
Bacchus Marsh ..	12	38	3·2
Panton Hill ..	24	514	21·5
PEAR PLOTS.			
Burwood East ..	30	706	23·5
Croydon	17	372	22·0
Doncaster ..	28	369	13·0
Tyabb	15	525	35·0

Codling Moth Lures.

The number of moths caught in lure pots constitutes a valuable aid for the correct timing of cover and ovicidal sprays for the control of codling moth. On all demonstration plots lures were

Lure pot showing method of suspension in the tree.

used, and the weekly catches of moths in each particular district were recorded on charts, posted up in convenient places, for the benefit of local growers.

Lures consisted of straight-sided glass jars (about 1⅓ pints capacity) containing an attractant fluid. In previous years, experiments conducted to determine the most suitable liquid for an attractant had shown that 10 per cent. malt vinegar solution was a suitable material, and consequently it was used on all demonstration plots. The jars were suspended (see illustration) in the upper half of the trees on the northern side, and contained approximately ¾ pint of 10 per cent. vinegar solution.

During part of the season weekly observations of the number of moths trapped were made, and the vinegar solution was changed regularly, either at weekly or fortnightly intervals. During the peak periods, viz., in early November, 28th November to 1st December, and February to March, observations were made twice, and sometimes three times, a week. Although the total

TABLE II.—LURE-POT RECORDS—NORTHERN DISTRICTS.

District.	Number of Lures.	Total Number of Moths Caught.	Number of Moths per Lure-Pot.
APPLE PLOTS.			
Harcourt—			
No. 1 ..	12	261	21·8
No. 3 ..	24	892	37·0
Strathfieldsaye ..	23	534	23·2
Quantong	10	99	9·9
Pomonal	20	711	35·5
Amphitheatre ..	10	161	16·1
Stanley	24	340	14·2
PEAR PLOTS.			
Harcourt—			
No. 1 ..	6	181	30·1
No. 2 ..	12	223	18·6
Bamawm	24	274	11·4
Kyabram	20	62	3·1
Ardmona	20	200	10·0
Shepparton ..	20	88	4·4

number of lure pots on each plot varied, they were distributed so that one lure was used to each twelve trees. This number was often in excess of the number actually required to indicate moth flight, but these pots served many other useful purposes on the demonstration plots.

The number of moths caught in each pot indicated in a general way, the variations in moth population which existed within a single orchard, or from orchard to orchard. At Croydon, where the average number of moths caught per pot during the spring peak was thirteen, it was expected that the problem of codling moth control would be greater than at Panton Hill, where the average catch was five moths per pot at the spring peak.

Malt vinegar (1 part by volume in 10 volumes of water) was used as a lure material on all plots, but at Wantirna, Tyabb, Shepparton and Lancaster, cider (1 part in 20 volumes of water) and molasses (1 part by volume in 16 volumes of water) were also used to compare their attractiveness, as lure materials, with vinegar. At Lancaster the moth population was not sufficiently high to justify any conclusions regarding the relative value of these lure materials, but on the other three plots, cider and molasses both proved superior to malt vinegar, particularly during the summer months when vinegar was liable to ferment and form a skin on the surface of the liquid, thus becoming less attractive to codling moths. This fermentation was checked by adding a few crystals of bluestone to each lure pot.

Cider gave slightly better results than molasses, and the marked superiority of these two materials, particularly during the summer months, suggests that the general use of malt vinegar may not have given a true picture of the magnitude of the second brood. Where cider and molasses were used in conjunction with vinegar, the number of second brood moths caught was nearly equal to the number of first brood moths caught; but where vinegar alone was used the number of second brood moths caught was relatively small. These results demonstrate the possibility of growers utilizing waste apples for the production of fermented apple juice, and employing this as a lure material.

Small tests were conducted with wine vinegar, the lees from sweet wine rackings, golden syrup, and unfermented apple juice, as lure materials, and indications were that these materials were superior to vinegar during the summer months, but not quite as efficient as cider. Further trials of these materials are necessary before definite recommendations can be made.

To use lure pots to the best advantage, careful observation and thought on the part of the grower is required. High moth catches in lure pots should not always be considered a good reason to proceed immediately with the application of a spray. Two to four days elapse before moths commence egg-laying, and the eggs take from seven to fourteen days to hatch, according to weather conditions; so that a period of some seven to sixteen days is available in which to spray before the fruit is liable to infection.

If the spray application be delayed as long as is practicable then the spray cover will be most efficient during the vital period of egg-hatching. White oil is essentially an ovicide, so that applications of oil should be made in that period following peak emergences when moth eggs are visible. This is usually from ten to fourteen days after the emergence. It may be necessary to apply more than one oil spray following a peak, as was done on the plots in Harcourt district. (See graph 5).

It can be seen also from the results obtained in codling moth control (Tables III. and IV.) that there was no definite correlation between lure catches and infection. Other factors, such as spray efficiency, crop conditions, &c., influence the final infection, while lure pot catches are influenced by such a variety of factors that they may give an incorrect impression of the infestation to be dealt with.

Codling Moth Activity, 1936-37.

To understand the prevalence and distribution of the codling moth population in the 1936–37 season, it is necessary to consider the population during the previous season. In Victoria, the season 1935–36 was particularly favourable to the codling moth, and in spite of continuous spraying, many orchardists experienced a very heavy infestation. It was expected, therefore, that a large number of larvae would over-winter, pupate, and then emerge to give a large 1936 spring brood of moths. This expectation was confirmed by the large numbers of moths caught in the lure pots during the period 28th November to 1st December on many of the demonstration plots.

On all the plots, except those at Pakenham Upper, Stanley and Amphitheatre, there was a minor peak emergence of moths during the period 3rd to 5th November. At Bamawm, Shepparton, Panton Hill, Bacchus Marsh, and Geelong, the peak emergence at this period constituted the main spring brood.

Both spring emergences were closely related to air temperatures. In early November in Melbourne, the daily maximum temperature ranged from 81° F. on 3rd November, to 96° F. on 5th November, and on the latter date the minimum temperature was 60° F.—a day very favourable for moth emergence. On 6th November, the lure pots were inspected and a large "catch" of moths was recorded for this warm period.

Between 7th and 26th November, the weather was unfavourable for moth activity in most districts, and relatively few moths were trapped. Temperatures began to rise again on 26th November, and on the 28th November, the maximum temperature in Melbourne was 95° F. and the minimum 58° F. The main spring brood emerged on this hot day.

Early December weather in southern districts was unfavourable for egg-laying, and very few moth eggs were observed until mid-December. Conditions north of the Divide were more favourable, however, and moth eggs were observed earlier in the month. These eggs hatched during the last two weeks in December, and therefore this became the critical period for first brood infection.

During late December and January, the number of moths trapped in lure pots remained very low and in a few cases no moths were recorded. In the southern districts, the second brood moths began to emerge during the second week of February, and reached a peak in some districts in late February, and in others, in early March. (See lure graphs.) In the northern apple districts, the emergence was slightly earlier, and reached a peak by mid-February, while in the northern pear districts this peak was recorded in the first week of February.

In most cases the emergence of moths in the late summer months was relatively low, and the rather cooler weather conditions, particularly in southern districts, were responsible, probably, for this reduced moth activity. The second brood was smaller in magnitude, and occurred too late to cause a high infection in the early and mid-summer varieties of apples. Late varieties were exposed to more infection and the usual difficulty of protecting this fruit was experienced.

APPLE PLOTS—SOUTHERN DISTRICTS.

Wantirna.

The Wantirna plot was established on the orchard of Mr. T. E. Butler. During the season the orchard changed hands and arrangements were made with the new owner, Mr. J. L. Murdoch, to continue the demonstration work.

The plot consisted of ten rows of Jonathan (360 trees)—six rows were sprayed with schedule "A" and four rows with schedule "B." As can be seen from graph 1, moth activity on this plot was characterized by a large spring brood in the period 28th to 30th November, and a somewhat smaller, but prolonged second brood, during the period mid-February to mid-March.

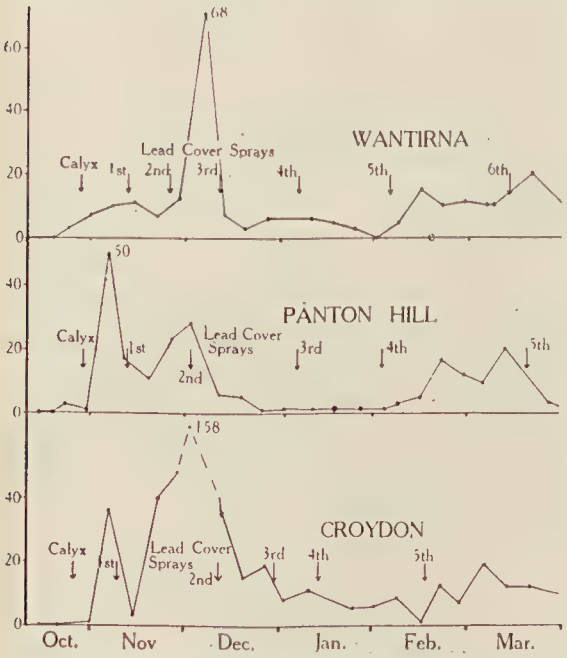
Owing to this second brood activity, and slightly premature applications of the first and second cover sprays, it was necessary to apply seven sprays in both schedules. The "A" schedule trees received seven lead arsenate sprays, and the "B" schedule trees, three lead arsenate sprays followed by four white oil sprays. The timing of these sprays is indicated on the lure graph. With more accurate timing of the early cover sprays, it may have been possible to reduce the number of sprays for the season, to six, and obtain equally good, or better, control. By delaying the first cover spray a few days, it would not have been necessary to apply the second cover spray until early December, and thus the spray applied on 10th December, may have been omitted.

Particulars of the codling moth infection, are set out in Table III., and in view of the high moth population on this orchard, the control obtained with both schedules, at the moderate cost for materials, of 9½d. and 1s. 1¾d. per tree for "A" and "B" schedules respectively, was highly satisfactory.

During the latter part of the season the "A" schedule trees showed a marked arsenical injury which appeared as a blotchy and marginal burn on the leaves, and finally resulted in a premature defoliation commencing with the basal leaves of the shoots. In contrast, oil-sprayed trees were carrying a healthy green foliage.

Black spot was successfully controlled by the programme adopted, and no infection was recorded.

The small percentage of russet present on this plot was probably due to the Bordeaux mixture (6 : 4 : 40) spray applied at the "green tip" stage. This conclusion is supported by the fact that the trees at the bottom of the plot were definitely more forward when this spray was applied, and russet was more prevalent in this section.



Graph 1.—Showing number of moths caught in 10 lure pots (weekly totals) at Wantirna, Panton Hill and Croydon.

Panton Hill.

The plot at Panton Hill was situated on the orchard of Mr. S. Cracknell and Son. At the outset, it consisted of Jonathans (161 trees), Red Romes (46 trees), Stewart's Seedling (23 trees), Taylor's Seedling (20 trees), and Green Alfriston (19 trees); but owing to the failure of Red Rome trees to set fruit, demonstration spraying on this variety was discontinued.

It had been intended to spray three rows of Jonathan, and the row of Green Alfriston, with "B" schedule, but owing to a misunderstanding regarding the use of white oil, this was not carried out. Lead arsenate sprays were used throughout the season.

Reference to Graph 1 will show that the main spring brood in this district was considerably earlier than elsewhere—7th November compared with 30th November—and although no eggs were observed on the fruit during November, the first entry was noticed on 1st December. This early brood was reflected, also, in the catch of grubs in hessian bands—the first catch was two to three weeks earlier than most districts—and in the nature of the second brood emergence.

Rain shortly after the spray application on 30th December made it necessary to repeat the spraying, so that a total of seven lead sprays was used on all varieties except Green Alfriston. The timing of these sprays is indicated on the lure graph.

The applications of lead arsenate on this plot were particularly heavy—the dosage, approximately 4 gallons per tree, being higher than any other district and probably greater than necessary for adequate and efficient protection of the fruit. Some arsenical injury, together with symptoms of potassium deficiency, were apparent on Jonathan near the end of the season, and it is probable that this injury was associated with the application of excessive amounts of lead arsenate spray.

Codling moth infection was very slight—2 per cent. on Jonathan and 2.8 per cent. on Green Alfriston, and the control achieved with the "A" schedule was therefore regarded as very satisfactory. No records were kept of the codling moth infection in Stewart's Seedling and Taylor's Seedling.

In this district it was necessary to apply only two sprays for the control of black spot, viz., the "green tip" Bordeaux mixture spray and the 3 : 80 lime sulphur spray at 5 to 10 per cent. blossom. With this programme complete control of black spot was obtained.

Croydon.

Situated on the property of Mr. W. Lipscombe, this plot consisted of two varieties—Jonathan (152 trees) and Democrat (152 trees).

For black spot and codling moth control, the spray programme on each variety was divided into "A" and "B" schedules. The programmes, as set out in the introductory remarks, were adhered to on each variety, with the exception that in "B" schedule, four lead arsenate sprays

followed by five white oil sprays—a total of nine sprays—were used for codling moth control.

Despite a prolonged and heavy emergence of the first brood during the period 20th November to 12th December (see Graph 1.), the infection prior to mid-January was low, which indicated that early lead sprays had provided good control. These sprays were efficiently applied and resulted in a particularly good cover of lead arsenate. During February and March a number of small peak emergences of moths occurred, and under such conditions, control with white oil sprays is difficult.

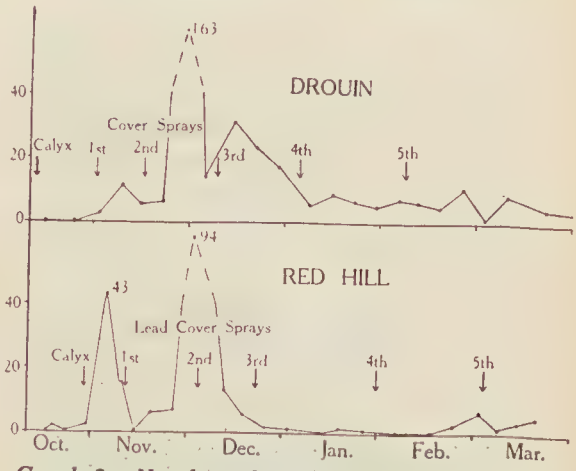
The results achieved in codling moth control are set out in Table III. The control under both spray schedules, on each variety, was quite satisfactory, when it is realized that the moth population, as indicated by the average number of moths trapped per pot (Table I.), was higher than on any other plot.

An analysis of the nature of the codling moth infection on this plot showed that the percentage of calyx entries was higher in the Democrat than in the Jonathan (2.4 per cent. as compared with 0.3 per cent.). This was probably influenced by the more open nature of the calyx of the Democrat variety.

No black spot infection occurred on this plot so that the control given by the spray programme adopted was very satisfactory.

Drouin.

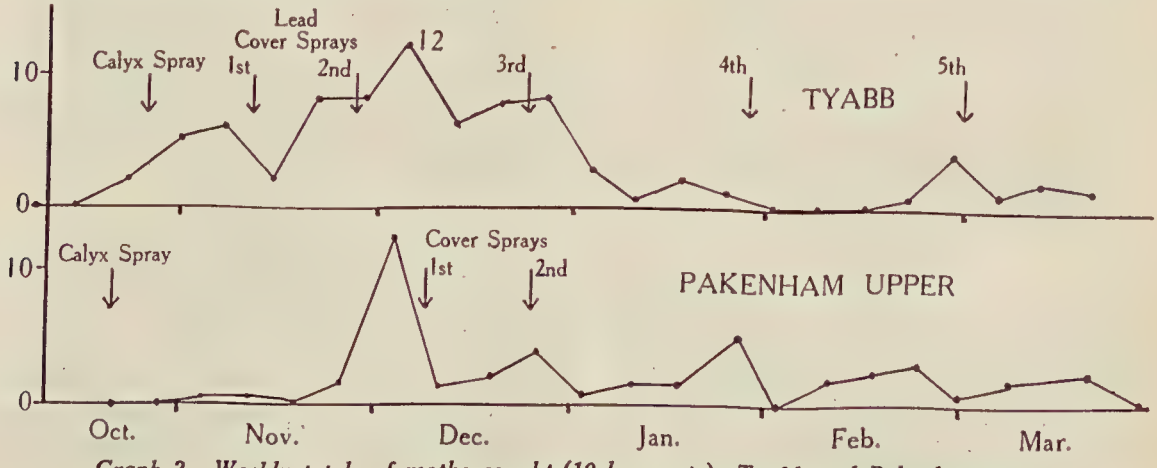
The plot at Drouin was located on the property of Mr. D. D. Grant, and consisted of Jonathan (150 trees), Rome Beauty (64 trees) and Delicious (64 trees). These latter two varieties were in a block in a different section of the orchard from the



Graph 3.—Number of moths caught in 10 lure pots (weekly totals) at Drouin and Red Hill.

Jonathan trees. For codling moth and black spot control spray schedules "A" and "B" were applied to the Jonathans, while schedules "B" and "C" were applied to each of the varieties—Delicious and Rome Beauty.

Lure graph 3 shows that the emergence of moths on this plot was typical of most of the southern districts. There was an abnormally large spring brood of moths in the last week of November, and moth activity was sustained during December, and then, following a period of reduced moth activity during January and February, a relatively small brood emerged in the first week of March. The weather following the spring brood emergence was unfavorable to egg-laying, so that early infection was not particularly severe, and the early cover sprays were successful in largely confining the mid-season infection to "stings."



Graph 2.—Weekly totals of moths caught (10 lure pots)—Tyabb and Pakenham Upper.

Only five lead arsenate sprays were necessary on "A" schedule Jonathan trees, but six sprays (four lead arsenate sprays followed by two white oil sprays) were considered necessary on Jonathan trees sprayed according to "B" schedule.

Owing to the size of the trees and the heavy crop on Rome Beauty and Delicious varieties, the limbs of the trees had to be "propped," and in consequence, it was impossible to apply sprays after 15th February, although a spray was necessary in early March. Only five sprays were applied to Rome Beauty trees under both schedules, and six sprays to the Delicious trees.

Table III. indicates the results obtained on each variety, and the control of codling moth on this plot can be regarded as very satisfactory. The slightly higher infection of the Rome Beauty variety is due partly to the susceptibility of this variety to codling moth attack, and partly to the higher moth population in this particular block. The emergence of moths from a packing shed nearby, contributed largely to this higher moth population.

Black spot is usually a serious problem in this high rainfall district (average annual rainfall approximately 40 inches), and the 1936-37 season was no exception where spraying was inefficient or was omitted. The programme of lime sulphur sprays following the 6 : 4 : 40 Bordeaux mixture spray applied at the "green tip" stage, was successful in controlling black spot on all three varieties, but the Bordeaux mixture programme ("C" schedule) did not give satisfactory results, particularly on Delicious trees.

Failure to completely spray the tips of high leaders with pre-blossom Bordeaux mixture sprays, and the continuous showery weather during November, resulted in black spot appearing on both Delicious and Rome Beauty varieties in late November and early December respectively, and a lime sulphur spray was applied to prevent the fungus from spreading. Black spot infection, as shown by examination at harvest, was as follows :—Jonathan "A" and "B"—Nil; Rome Beauty "C"—2.1 per cent.; Rome Beauty "B"—0.6 per cent.; Delicious "C"—9.1 per cent.; and Delicious "B"—1.6 per cent.

Red Hill.

The Red Hill plot, consisting of two varieties, Jonathan (282 trees), and Rome Beauty (102 trees), was situated on the orchard of Mr. G. W. Brown. The Jonathans, comprising eight rows of trees, were sprayed with schedule "A" (four rows), and with schedule "B" (four rows). The Rome Beauty trees were similarly divided into two rows, schedule "A"; and two rows schedule "B," so that the two spray schedules were applied on both varieties.

As shown on lure graph 3 the emergence of codling moths was similar to that in most districts. A moderate peak on 4th and 5th November, preceded the very large spring brood emergence on 28th to 30th November, and, following a period of inactivity in January and early February, a small second brood appeared in early March.

Six sprays for codling moth control were applied to both varieties. Lead arsenate alone was used in schedule "A," while in schedule "B" four lead arsenate sprays followed by two white oil sprays were used on Jonathan trees, and three lead arsenate sprays, followed by three white oil sprays, on Rome Beauty trees.

The extent of the codling moth infection is set out in Table III., and may be regarded as quite satisfactory. The slightly higher infection on Rome Beauty is associated with such factors as susceptibility, late season variety, and light crop.

The Bordeaux mixture and lime sulphur programme gave effective control of black spot on Jonathans, but on the Rome Beauty trees, leaf spot appeared in late January, following humid weather, and it was necessary to include a 2 : 3 : 80 Bordeaux mixture with the lead arsenate and white oil sprays applied at this time. This was successful in checking the spot, and at harvest time, only one fruit in 500 (0.2 per cent.) was infected.

Tyabb.

The demonstration plot in the Tyabb district was conducted on the orchard of Messrs. S. C. Borley and Son, and consisted of a very even block of Jonathan trees. The plot was divided into two sections, one, consisting of 130 trees being sprayed with schedule "A," and the other, of equal size, with schedule "B."

In this district, owing to the terms of an agreement under which hives of bees are distributed in the orchards at blossom time, it was impossible to apply an early calyx spray of lead arsenate on schedule "B." As a result, the "B" schedule differed from the "A" schedule, only in the fact that the last two sprays were white oil. The four earlier applications were lead arsenate sprays in both cases.

A prolonged emergence of the spring brood was a feature of the moth activity on this plot. Moths were caught in relatively large numbers over the period 18th November to 24th December. Lead arsenate alone was used throughout the plot during this period and up to mid-January. Very

few moths emerged during January and early February, but during the period 18th to 28th February, a large second brood was recorded. In "B" schedule, white oil alone was used to control this brood.

The results achieved in codling moth control, viz., "A" 1·7 per cent.; "B" 3·4 per cent. infection, are considered very satisfactory.

No black spot infection occurred on this plot, so that the control achieved by the programme of Bordeaux mixture followed by three lime sulphur sprays was excellent.

Applying the first lime-sulphur spray (3 : 80) on the demonstration plot at Pakenham Upper.

Pakenham Upper.

This plot was conducted on Mr. I. Woolf's orchard "Valleyview," at Pakenham Upper, and comprised three varieties, viz., Jonathan (336 trees), Yates (84 trees), and Delicious (103 trees). Four rows of trees—two each of Yates and Delicious, sprayed according to "A" schedule—separated the Jonathan trees into two equal sections, one of which was sprayed with schedule "A" and the other schedule "B".

Codling moth activity in this district is indicated in the lure graph which shows that a small spring brood emerged during the 20th to 30th November, and, prior to that date, moth activity was negligible. Very small peaks were recorded in late December and during the last week of February, but there was no indication of a second brood.

The low moth population (Table I.) and the fact that there was one brood only, simplified codling moth control, and it was found necessary to apply three lead arsenate sprays only to the varieties sprayed with schedule "A." The timing of these sprays is indicated in lure graph 2.

The Jonathan trees sprayed according to "B" schedule received four lead arsenate sprays—two calyx sprays and two cover sprays. Although white oil was introduced into the "B" schedule in mid-February, it was not considered necessary for codling moth control. It was used in combination with nicotine sulphate, and applied primarily for woolly aphis control.

The results achieved in the control of codling moth (Table III.) on this plot at the average cost of 3d. per tree for spray materials, are highly satisfactory. The slightly higher infection on the "B" schedule, Jonathan trees, was due largely to the influence of moths emerging from a stack of cases near the shed at the top of this block.

Black spot was successfully controlled by the spray programme as set out in schedules "A" and "B," and no infection occurred.

Russet was prevalent on Jonathan trees on this plot, and was attributed partly to the effect of the 6 : 4 : 40 Bordeaux spray on the more advanced buds, and partly to the effects of the lime sulphur spray (1½ : 80) applied fourteen days after "petal fall." This latter spray caused a foliage injury, and later, russet appeared on the fruit.

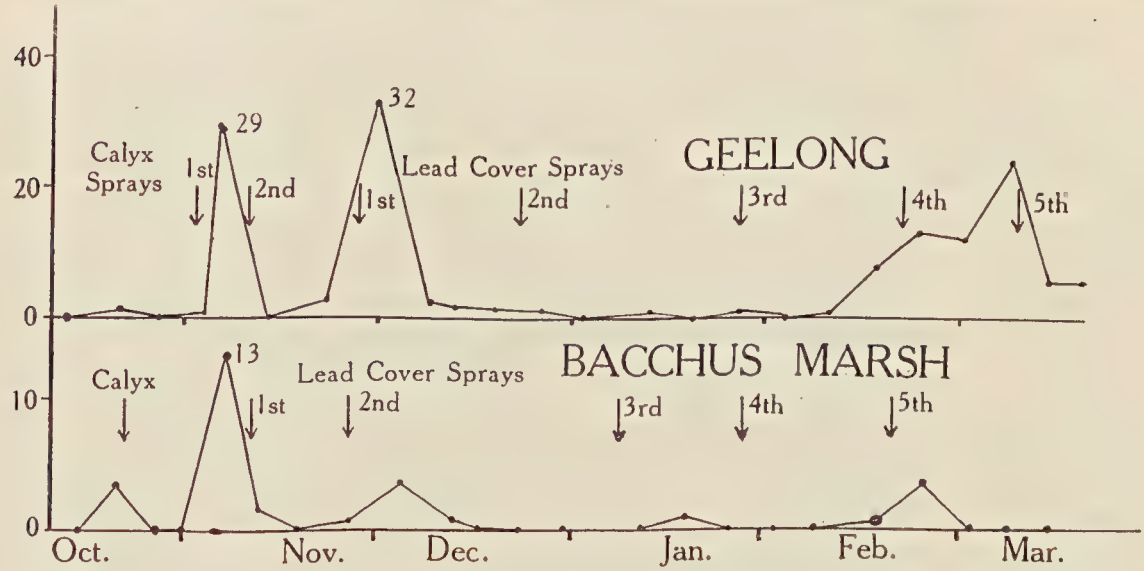
Geelong.

The Geelong district plot was situated on the orchard of Mr. P. Ling and Son at Wallington, and consisted of Dunn's (74 trees), Delicious (51 trees), and Rome Beauty (204 trees). Schedule "A" was applied to the Dunn's, Schedule "B" to the Delicious, and four rows of Rome Beauty comprising 135 trees, and the balance of Rome Beauty trees (69 in number), was sprayed according to schedule "C."

The lure graph 4 shows that two peak emergences of moths occurred in the spring—one from the 4th to 6th November, the other from the 28th to 30th November, and, following a period of reduced activity during the summer, a second brood emerged during the first week of March.

Seven sprays were used throughout the plot, except on Rome Beauty trees sprayed with schedule "C," where six lead arsenate sprays were regarded as sufficient. The timing of these sprays is indicated on the lure graph.

Control of codling moth on Delicious and Rome Beauty varieties presented some difficulties. The



Graph 4.—Showing weekly totals of codling moths caught in 10 lure pots at Geelong and Bacchus Marsh. Note difference in scales (number of moths) for the two centres.

crop on these varieties was very light, and carried mainly in bunches on the tips of laterals. As a result, it was difficult to get a good spray cover where the fruit was in contact, and many entries were made at this point. Again, the foliage of Rome Beauty trees was very dense, and it was therefore difficult to apply a penetrating spray and cover those apples near the centre of the tree.

Particulars of the codling moth infection on each variety are set out in Table III. The degree of control achieved on the Dunn's (5.0 per cent. infection) was quite satisfactory; but the extent of this infection on Rome Beauty and Delicious varieties, leaves room for improvement.

In a season when the crop is nearer normal, better control could be achieved by more careful timing of cover sprays.

The foliage of the trees sprayed with white oil following lead arsenate was noticeably healthier than those sprayed with lead arsenate throughout the season. This was due to the failure of lead arsenate to control red spider, and the presence of a slight arsenical spray injury.

Black spot control was successfully achieved with both spray schedules. The Bordeaux mixture and lime sulphur programme as set out in schedules "A" and "B", was slightly modified. The final spray of lime sulphur ($1\frac{1}{2}$: 80) was omitted so that two lime sulphur sprays only were applied. Black spot infection on the Rome Beauty trees which received two Bordeaux mixture sprays only (schedule "C") was negligible (0.9 per cent.), and in view of the low cost of this spray programme, $\frac{3}{4}$d. per tree, it should commend itself to growers in this district.

Bacchus Marsh.

The Bacchus Marsh plot, situated on the orchard of the late Mr. A. Durham, was one of the smaller spray demonstration plots, and consisted of Jonathan (54 trees) and Granny Smith (54 trees). An equal number of Delicious trees was originally included, but owing to their failure to set fruit, they were omitted. The plot was divided into two sections, each containing the two varieties, and spray schedule "A" was applied to one, and schedule "B" to the other.

The lure graph indicates the moth activity on this plot during the season. The spring brood, a very small one, emerged in early November, and following a minor peak in early December, one moth only was caught during the period 20th December to 12th February. A small second brood was recorded in the last week of February.

Six sprays for codling moth control were applied on this plot. On trees receiving "A" schedule six lead arsenate sprays were used, while on "B" schedule trees, three lead arsenate sprays were followed by three white oil sprays. The timing of these sprays is indicated on lure graph 4.

The infection under both schedules (Jonathan "A" 2.1 per cent.; "B" 5.2 per cent.; Granny Smith "A" 6.4 per cent.; "B" 7.7 per cent.) was higher than the moth population, as indicated by

TABLE III.—APPLE PLOTS—SOUTHERN DISTRICTS. CODLING MOTH INFECTION.

District.	Variety.	Spray Schedule.	Number of Trees.	Average Yield of Fruits per Tree.	Codling Moth Infection.		
					Entries Percentage of Total Yield.*	Stings Percentage of Total Yield.	Total Percentage.
					%	%	%
Drouin	Jonathan ..	A	75	700	2·3	3·4	5·7
	Jonathan ..	B	75	590	2·9	2·9	5·8
	Rome Beauty ..	C	32	950	3·3	4·6	7·9
	Rome Beauty ..	B	32	2,050	2·9	3·4	6·3
	Delicious.. ..	C	32	2,410	0·3	1·1	1·4
	Delicious.. ..	B	32	1,510	1·4	2·2	3·6
Pakenham	Jonathan ..	A	169	550	1·3	1·0	2·3
	Jonathan ..	B	163	570	2·1	1·2	3·3
	Yates	A	84	590	1·5	1·1	2·6
	Delicious ..	A	84	380	0·4	0·3	0·7
Tyabb	Jonathan ..	A	130	700	1·4	0·3	1·7
	Jonathan ..	B	130	560	3·0	0·4	3·4
Red Hill	Jonathan ..	A	154	930	2·2	1·4	3·6
	Jonathan ..	B	128	970	2·6	1·1	3·7
	Rome Beauty ..	A	38	445	4·3	2·9	7·2
	Rome Beauty ..	B	64	315	4·2	2·3	6·5
Wantirna	Jonathan ..	A	216	800	2·8	2·2	5·0
	Jonathan ..	B	144	775	3·9	1·0	4·9
Croydon	Jonathan ..	A	64	760	2·7	1·8	4·5
	Jonathan ..	B	64	800	5·7	1·0	6·7
	Democrat ..	A	64	620	3·1	0·9	4·0
	Democrat ..	B	64	640	6·4	0·6	7·0
Wallington (Geelong) ..	Rome Beauty ..	C	69	400	12·7	1·6	14·3
	Rome Beauty ..	B	135	250	15·3	1·2	16·5
	Dunn's	A	74	670	5·0	1·3	6·3
	Delicious.. ..	B	51	350	10·4	1·3	11·7
Bacchus Marsh ..	Jonathan ..	A	26	230	0·8	1·3	2·1
	Jonathan ..	B	26	240	3·1	2·1	5·2
	Granny Smith ..	A	26	145	2·0	4·4	6·4
	Granny Smith ..	B	26	75	4·3	3·4	7·7
Panton Hill	Jonathan ..	A	160	550	1·4	0·6	2·0
	Green Alfriston ..	A	19	340	2·3	0·5	2·8

* Yield and infection include windfalls.

lure catches, would lead one to expect, and it is possible that on this plot the lure pots did not give a good indication of the population prevailing from week to week. The vinegar fermented considerably during the early summer months, but later, fermentation was prevented, and this undoubtedly increased the value of vinegar as a lure material. Reference to the value of vinegar as a lure material has already been made. The higher infection was influenced also by the fact that the crop was very light.

Black spot was successfully controlled with the Bordeaux mixture and lime sulphur spray programme and no infection occurred. The final spray of lime sulphur $1\frac{1}{2}$: 80 was not considered necessary, so that, as at Geelong, two lime sulphur sprays only were used.

APPLES—NORTHERN DISTRICTS.

Quantong.

The Quantong plot, consisting of 88 trees, was located on Mr. R. Gersch's orchard, and included three varieties, all of which were sprayed according to schedule "B," with the exception, that only

the green tip Bordeaux spray was applied for black spot control. The three varieties were Rome Beauty, Rokewood, and Cleopatra.

For codling moth control, two calyx sprays were followed by two cover sprays of lead arsenate. White oil was introduced on the 7th December, except in the case of Rome Beauty, to which the first oil was applied on the 24th December. Three, four and five oil sprays were applied to Cleopatra, Rome Beauty, and Rokewood, respectively.

The results obtained were not satisfactory, but the very light crop was an important factor contributing to the difficulty of maintaining control of codling moth on this plot. Further, the first brood was active over a very long period without a well-defined peak activity. Consequently, it proved difficult, with the number of sprays applied, to maintain an efficient lead arsenate cover and to apply white oil sprays to the best advantage.

A feature of the infection was the high proportion of calyx entries. These amounted to 50 per cent. of the entries recorded in Rome Beauty and Rokewood.

Although the risk of black spot infection is regarded as negligible in the Quantong district, it was thought advisable to apply Bordeaux mixture at least at the "green tip" stage. A trace only of black spot infection was recorded, and this feature of the Quantong district enabled a very definite reduction in spray costs to be made there.

Amphitheatre.

The plot on Mr. W. Collins' property at Amphitheatre was a small one, comprising 83 trees, and included the three varieties—Dunn's (28 trees), London Pippin (25 trees), and Jonathan (30 trees), all of which were sprayed according to schedule "B."

For the control of codling moth, each variety received two calyx sprays (except London Pippin, which was sprayed only once at the calyx stage) and three lead arsenate cover sprays. After the last lead arsenate cover spray on 23rd December, no sprays were applied until 9th February, when the first white oil spray was applied. For the control of the second brood five white oil sprays were used. In all, ten sprays were applied to Jonathan and Dunn's, and nine to London Pippin.

The emergence of the spring brood moths, as shown in the lure graph, reached a peak on 2nd December. Following this peak, eggs were laid freely during December, and consequently this period was very important for the control of codling moth. During January, moth activity was much lower, but early in February the emergence of a second brood commenced, and continued until late in March.

The degree of codling moth control obtained on this plot was poor. (Table IV.). Of the several factors contributing to the high infection, the most important was the failure to maintain an efficient cover of lead arsenate during December and January. This was due to heavy rains in mid-December, together with the rapid growth of fruit at this time. The first two lead arsenate cover sprays would have provided a more effective cover had their application been delayed for a week in each case.

During early January the spray cover was not renewed because it was thought at the time, that the cover resulting from the last December application was still able to maintain control. During the month, however, there was a gradual increase in infection which would have justified an extra lead arsenate cover spray during the second week in January. The omission of this spray meant that a long interval passed before moth activity was great enough to justify the application of an ovicidal (white oil) spray.

Following the emergence of the second brood, conditions became more favorable for applications of white oil to combat the apparently small, but prolonged, second brood. Five oil sprays were applied.

A feature of the infection on this plot was the high degree of calyx infection, particularly in Jonathan and London Pippin. More than 40 per cent. of the infection (excluding stings) in these varieties took place in the calyx. This suggests that the spray application was not as thorough as it should have been. Much of the infection took place where the fruits were in contact, and in a heavy crop, such as existed at Amphitheatre; infection taking place in this way is not always apparent.

The use of schedule "B" for black spot effectively controlled this disease under the conditions prevailing during the 1936–37 season.

Pomonal.

The plot at Messrs. Cox Bros.' orchard, Pomonal, comprised 220 trees of the one variety Cleopatra. Schedule "C" was adopted for the bulk of the plot, and only a small section of eighteen trees was treated with white oil because of the risk of spray injury to this variety. Another small section of twenty trees was sprayed according to schedule "A."

For the control of codling moth, eight sprays were applied, including two calyx sprays which were necessary because of the prolonged flowering

period of the trees. In the case of the section treated with white oil, two calyx sprays and one lead arsenate cover spray were followed by five white oil sprays.

A very important factor in the poor results obtained (see Table IV.) was the high population which existed on this plot. This was shown by the abnormally high catch of moths recorded in lure pots during the week ending 5th December. This was followed by a critical period extending into early January, during which it was essential to maintain a good cover of lead arsenate. Although a prolonged second brood was evident in February and March, the main harvesting was completed by the end of February.

Actually, more than 70 per cent. of the season's infection took place during December and early January, following the large emergence of moths in early December, and consequently it was necessary to maintain an efficient cover of lead arsenate during the critical period. Difficulty was experienced in applying and maintaining an efficient cover in December, due chiefly to the light crop on the bulk of the plot, the very rapid growth of fruit in December, and the occurrence of rains during the same period.

A spray applied to portion of the block on 12th November was not only unnecessary, but also, owing to rain following its application, re-spraying was necessary on 20th November. The second cover spray applied on 3rd December should have been delayed five to seven days.

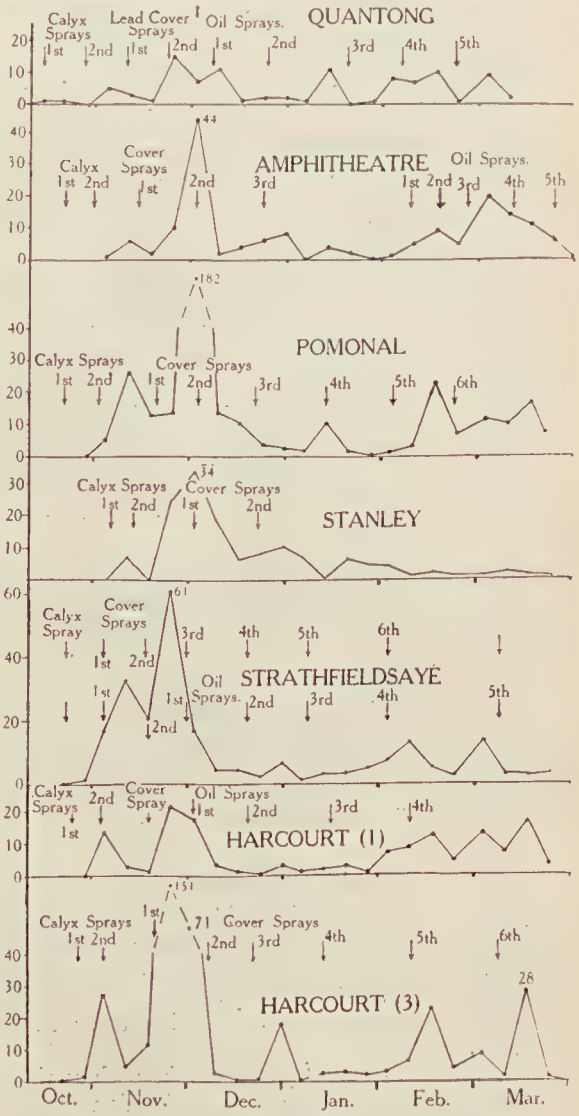
It is noteworthy that 70 per cent. of the total infection in the "C" schedule fruit consisted of "stings," indicating that although lead arsenate destroyed the larvae, it was not before the fruit had been blemished. Considerable calyx infection, amounting to 14 per cent. of the infection, excluding "stings," was recorded.

The small section sprayed according to schedule "B" received two oil sprays in December, but unfortunately the first spray was applied at a much weaker strength than was intended, and therefore no conclusions can be drawn from the results obtained with white oil at Pomonal.

Schedule "C" effectively controlled black spot under the conditions prevailing in the spring of 1936, and a trace only (0·1 per cent. to 0·2 per cent.) of black spot was recorded.

Stanley.

Two varieties, Granny Smith and London Pippin, were available for the demonstration of black spot and codling moth control at Mr. N. Pope's orchard, Stanley.



Graph 5.—Showing codling moth catches in 10 lure pots—Northern Apple Districts.

The control of codling moth was comparatively easy because one brood only of moths emerged and conditions were not as favorable for development as in other districts. Calyx spraying was followed by two lead arsenate cover sprays and the final spray was applied on 30th December, to London Pippin. With more efficient spraying codling moth infection could have been reduced to negligible proportions.

Owing to the abnormally high rainfall, black spot is a major problem at Stanley. Although the rainfall in the 1936–37 season was below normal, over 20 inches of rain fell during the

growing period, and over 4 inches of this fell during October and November.

For black spot control schedule "C" was used for Granny Smith, and schedule "A" for London Pippin, with the addition in the latter case, of an extra lime sulphur (¾ : 80) spray. The better control of spring spot obtained with schedule "A" on London Pippin (see Table IV.) was due to the fact that this schedule provided protection over a longer period. No protective spray was applied to Granny Smith after the 10th October. By the end of November, 4 inches of rain had fallen, and during late November black spot made its appearance on the foliage of Granny Smith.

Black spot did not appear on London Pippin until December. This variety was situated in a particularly susceptible section of the orchard and conditions favoured an outbreak of summer spot. In addition, inefficient spraying of the tips of the leaders provided an important source for summer spot infection. The percentages of black spot infected fruit were, London Pippin—2·4 per cent., and Granny Smith, 3·3 per cent.

The cost of spray materials for black spot control in London Pippin was 7½d. per tree. If schedule "C" had been used, the cost would have been 3d. less, but it is considered that more than two sprays should be provided as in schedule "A," and therefore the more costly schedule was justified. For codling moth control the costs of materials were only 4½d. and 3½d. per tree for Granny Smith and London Pippin respectively.

Strathfieldsaye.

At Strathfieldsaye the plot was located on Messrs. Somerville Bros.' orchard, and comprised 3½ acres. The varieties included in the plot were Dunn's (180 trees), Cleopatra (88 trees), and Granny Smith (68 trees).

Provision was made for the demonstration of "A" and "B" schedules on the block of Dunn's; 42 trees were sprayed according to schedule "A" and the remainder according to schedule "B." Schedule "B" was adopted for the Cleopatra and Granny Smith section of the plot, with the exception, that half of each section was sprayed according to schedule "C" for black spot control.

The main emergence of the spring brood of codling moth commenced in early November, and reached a peak during the last week of November. (See lure graph 5). During December and early January following this very substantial peak, infection increased very rapidly, and, in fact, approximately 70 per cent. of the season's infection in Dunn's took place during this period. This emphasizes the necessity for efficient spraying to maintain cover during the periods following the emergence of the main broods. Moth activity diminished during January, but increased again in February, and, following the peak on 10th February, there was a further substantial increase in infection.

For codling moth control all varieties received one calyx spray, two cover sprays of lead arsenate and four white oil sprays. Granny Smith required an additional white oil spray. The first white oil spray was applied on the 1st December, and was followed by a further one on the 21st December. Other oil sprays were applied on the 8th January and 3rd February, and to Granny Smith on the 6th March.

The results obtained in the control of codling moth at Strathfieldsaye were not entirely satisfactory even when it is considered that the initial population was high as a consequence of the very heavy infection in the previous season. No difficulty was experienced in controlling codling moth in Cleopatra, but the results in Dunn's and Granny Smith were poor. Prior to the time of the Field Day, held on 4th February, the control of codling moth obtained on the light crop of Granny Smith was satisfactory.

The principal reason for the high infection in Granny Smith was that a spray required during

A Field Day at Strathfieldsaye (near Bendigo). Growers discussing the results of spraying on the demonstration plot.

the third week of February was not applied. Consequently there was a rapid increase of infection and at harvest time a high percentage of young larvae was recorded in the fruit. This same factor also applied to Dunn's, but, as previously indicated, 70 per cent. of the season's infection occurred during December and early January. At that time the total infection on the "A" section was approximately three times that on the "B" section. The superior position of the "B" schedule was due to the fact that white oil sprays were applied in December, at a time when eggs were particularly abundant. The first oil spray applied on 1st December could have been delayed a week with advantage.

The first cover spray of lead arsenate (4th November) could have been delayed for twelve to fourteen days, and if this had been done one cover spray could have been omitted without increasing the infection from the first brood.

No black spot infection was recorded with either of the schedules adopted, and, in fact, under the weather conditions prevailing during the spring of 1936, the "B" schedule could have been modified with advantage by omitting the third lime-sulphur spray. For black spot control the cost of the "C" schedule sprays was less than half that of the "B" schedule sprays, but provided protection only in the pre-blossom stage.

The main feature arising out of the use of the two schedules was the injury produced by lime-sulphur, particularly to Cleopatra and Granny Smith varieties. This injury was apparent for most of the season but had no influence on the season's crop.

Harcourt.

Two apple plots were located in the Harcourt district at the orchards of Messrs T. Code and Ford Bros. These are referred to in Table IV. as Harcourt Nos. 1 and 3 respectively.

The time of emergence of the spring brood of moths was practically the same on both plots. During the first week of November substantial lure catches were associated with favourable conditions for egg-laying. The main emergence of the spring brood did not occur until late November, and at Messrs. Ford Bros. the catch of moths

TABLE IV.—APPLE PLOTS—NORTHERN DISTRICTS. CODLING MOTH INFECTION.

District.	Variety.	Spray Schedule.	Number of Trees.	Average Yield of Fruits per Tree.	Codling Moth Infection.		
					Entries Percentage of Total Yield.*	Stings Percentage of Total Yield.	Total Percentage.
					%	%	%
Harcourt—							
No. 1	Dunn's	B	68	470	2·1	1·1	3·1
No. 3	Dunn's	B	165	550	6·0	1·9	7·9
	Jonathan	B	99	1,000	2·8	3·6	6·4
	Jonathan	A	66	1,170	3·0	6·6	9·6
Strathfieldsaye	Dunn's	A	42	550	18·7	16·2	34·9
	Dunn's	B	138	410	13·2	3·2	16·4
	Cleopatra	B	44	700	2·9	1·5	4·4
	Granny Smith	B	66	316	21·2	2·1	23·3
Quantong	Cleopatra	B	33	258	6·6	5·0	11·7
	Rome Beauty	B	33	730	13·5	5·8	19·3
	Rokewood	B	22	200	16·3	9·0	25·3
Pomonal	Cleopatra	C	180	293	7·4	16·8	24·2
	Cleopatra	B	18	785	14·6	20·4	35·0
	Cleopatra	A	20	1,025	8·5	15·0	23·6
Amphitheatre	Dunn's	B	28	1,060	11·9	7·6	19·5
	Jonathan	B	30	1,200	5·2	6·2	11·4
	London Pippin	B	25	770	10·8	7·2	18·0
Stanley	Granny Smith	C	56	372	1·8	0·6	2·4
	London Pippin	A	92	490	4·0	0·5	4·5

* Yield and infection include windfalls.

was particularly high. The emergence of a second brood of moths commenced early in February, but the lure-catch records indicated that this brood was relatively unimportant during the 1936–37 season.

The first infection was observed during the third week of November, following the moth activity in early November. The main period of infection occurred during December following the major peak in late November. Eggs were detected most readily during the second and third weeks of December, and the hatching of these eggs caused a rapid increase in infection during the latter half of December.

Harcourt No. 1 (T. Code).

This plot was sprayed entirely according to schedule "B." For codling moth control one calyx spray, two lead arsenate cover sprays, and four white oil sprays were applied. To combat the moth activity of early spring, 1936, the cover spray applied on 3rd November was too early to be of any value as such, but it had some value as a late calyx spray. The first white oil spray on 2nd December was applied a few days too early to be most effective. This spray was followed by another on 19th December.

The good results obtained on this plot (see Table IV.) were largely due to the thorough application of the sprays during the critical month of December, together with the fact that the initial population was not excessive.

Schedule "B" provided complete protection from black spot infection and under the conditions prevailing in 1336 it was not considered necessary to apply a third lime-sulphur. Considerable foliage and blossom injury resulted from the first and second lime-sulphur sprays, and this was more apparent on this plot because of the unthrifty condition of the trees.

Harcourt No. 3. (Ford Bros.).

The plot consisted of two varieties—Dunn's (165 trees) and Jonathan (165 trees). The Jonathan block was divided into two sections so that the operation of schedules "A" and "B" could be demonstrated. All of the Dunn's block was sprayed according to schedule "B."

For the control of codling moth in Dunn's, one calyx spray, two lead arsenate cover sprays and four white oil sprays were applied. The same programme was used for Jonathan, with the addition of an extra oil spray. The dates of application of the sprays for the "A" schedule on Jonathan were practically the same as for the "B" schedule (see lure graph 5). As at Mr. T. Code's plot, the first cover spray applied on 4th November was of little value as such, but had some value as a late calyx spray on Jonathan.

Two white oil sprays were applied on the 7th and 21st December, and both of these were considered essential to deal with the large initial population on this plot. These two sprays were the main factors in the superior position of the "B" schedule at the end of the season, and showed that white oil thoroughly applied when eggs are abundant, can give improved control.

The provision of three more white oil sprays to Jonathans in January, February, and March, together with a heavy rate of application, made the "B" schedule very costly on this plot. The cost of materials for "B" schedule trees was 1s. 9¾d., as against 1s. 2¾d. for "A" schedule trees. Thus, for the expenditure of 7d. more per tree, only 50 less fruit per tree were infected. These Jonathan trees carried a crop estimated at five to six bushels per tree.

Complete control of black spot was achieved with schedule "B" which was modified by omitting the third lime-sulphur spray. This spray was omitted because there was no evidence of black spot, and the weather conditions at the time did not warrant its application.

Recommendations for Control of Black Spot.

To give growers the opportunity to prepare for the spring spraying programme against black spot this section has been included with this portion of the article.

The principles adopted for the control of black spot of apples and pears on the demonstration plots have already been outlined in the introductory remarks. The most efficient preventive commercial fungicide is Bordeaux mixture and this is used wherever possible. Its use on apple varieties liable to russet is restricted to the earliest pre-blossom application. In the case of apple varieties susceptible to Bordeaux injury, viz., Jonathan, Dunn's, Yates, London Pippin, Gravenstein, &c., it is necessary to use lime sulphur after the "green tip" Bordeaux mixture spray.

For pears, three applications of Bordeaux mixture are recommended. The first two are made at the "green tip" and "finger tip" stages respectively, at the full strength of 6 : 4 : 40. The third Bordeaux mixture (3 : 3 : 50) is combined with a lead arsenate spray and applied two to three weeks after petal-fall (i.e., the calyx spray).

Attention should be given to those varieties, such as Packham's, Winter Nelis, and Josephine,

which require special treatment as outlined in the introduction. It is recognized that the application of a third Bordeaux mixture spray to Winter Nelis can be expected to cause russet to this variety, but no alternative is available without reducing the margin of control.

In the case of apples it is recommended that a Bordeaux mixture (6 : 4 : 40) spray should be applied at the "green tip" stage and that the subsequent sprays be of lime sulphur. These latter sprays will be applied at 5 to 10 per cent. blossom, petal-fall, and again a fortnight later at the strengths of 3 : 100, 2 : 100, and 1½ : 100. respectively. The number of lime sulphur sprays may be reduced or increased as seasonal conditions warrant.

A lower strength of lime sulphur than used previously is suggested because of the increased polysulphide content of lime sulphurs now on the market.

For those growers who prefer to use Bordeaux mixture, the first lime-sulphur spray can be replaced by a half strength Bordeaux mixture (3 : 3 : 50) applied at the "pink" stage (i.e., earlier than the 5 to 10 per cent. "blossom" for lime sulphur).

Details of the pear demonstration plots, costs of spray materials, recommendations for the control of codling moth, spray injury, etc., will be dealt with in a subsequent issue of this Journal.

Butter Production and Export

The following table shows :—

(*a*) Factory production of butter and cheese in Victoria for the period July, 1936, to May, 1937, compared with the corresponding period of 1935–36 ; and

(*b*) Quantities and percentages of various grades of bulk butter examined for export in Victoria from 1st July, 1936, to 30th June, 1937, in comparison with the corresponding period of 1935–36.

FACTORY PRODUCTION OF BUTTER AND CHEESE IN VICTORIA (QUANTITIES IN TONS).

Month.	Butter.		Cheese.	
	1936–37.	1935–36.	1936–37.	1935–36.
July to February	53,070	52,767	4,516	3,922
March	5,065†	3,589	423	263
April	3,743†	2,853	333†	226
May	2,834†	2,406	290†	204
Totals, 11 months	64,712†	61,615	5,562†	4,615

† Subject to revision.

BULK BUTTER EXAMINED FOR EXPORT IN VICTORIA (QUANTITIES IN TONS).

Period.	1936–37. How Graded—				Total.	Period—	1935–36. How Graded—				Total.
	Ch.	1st.	2nd.	Pty.			Ch.	1st.	2nd.	Pty.	
1st July to 29th May	27,264	9,167	2,662	438	39,531	1st July to 30th May	22,304	11,652	2,832	430	37,218
30th May to 30th June	18	10	29	2	59	31st May to 30th June	41	19	29	8	97
Totals 1st July to 30th June ..	27,282	9,177	2,691	440	39,590	Totals 1st July to 30th June ..	22,345	11,671	2,861	438	37,315
Percentages ..	68·9	23·2	6·8	1·1	..	Percentages ..	59·9	31·3	7·6	1·2	..

Orchard and Garden Notes

By Edward E. Pescott, F.L.S.

The Flower Garden.

SEEDS of hardy late spring or early-flowering summer annuals may now be sown. A nice bed of sandy soil intermixed with leaf mould should be made up in a warm position, where on bright days it will get sunshine all day long. Preparation should be made so that it will be possible to cover the bed with a hessian or calico frame at night and also during windy days.

Seed should be sown evenly over the bed and covered lightly with a fine loose soil. Some old loose and well broken up leaf mould may be crumpled up and spread all over the surface of the bed.

Among the seeds to be sown will be Sweet Pea, Carnation, Petunia, Aquilegia, Balsam, Candytuft, Nasturtium, Pansy, Viola, Calendula, Zinnia, Aster, Didiscus, Lupin, Scabious, Sweet William, and Tithonia. A selection of climbing plants for sowing would include Canary Creeper, Cardinal climber, Mina lobata, Cobaea scandens and Lathyrus pubescens.

Herbaceous plants, including Canna, Delphinium and Perennial Phlox, should be planted in soil into which some good rich manure has been worked. If early Delphinium blooms are required, the crowns should be planted in a sunny situation.

Rose aphis will soon be showing. When it does, the bushes should be well sprayed with nicotine sulphate, and the spray repeated a few days later.

The Vegetable Garden.

For a crop of early tomatoes a bed should now be prepared. It must be deeply dug over and manure in the form of humus worked into the soil. In setting out the young plants, arrangements should be made to guard them from cold winds. It will also be an advantage to protect or cover them during cold nights. Weak, drawn, or pale-coloured plants should not be set out into the garden. All plants must be "hardened off"

A Double Petunia.

before transplanting. Weakly plants are very slow in establishing themselves, and many of them will die; therefore only well-coloured, sturdy, and strong plants should be selected for planting out.

Similar work and precautions are required for crops of marrows, pumpkins, cucumbers and similar plants. Deep trenching and enrichment of the soil are very important. All these plants are gross feeders; further, they need ample water during the hot weather. Preparation for a supply of manure and for watering should now be made.

A sowing of late green peas may be made for the Christmas and New Year picking. When sowing the seed, both soil and seed should be given a good dusting of lime or soil fumigant to save the germinating seed from attacks of soil pests, such as slugs, snails, slaters and psoccids.

The Orchard.

Where the codling moth population has been extensive, it will be wise to catch as many larvae as possible, before they pupate into the chrysalis stage. Hessian bands on the trees will trap the larvae that have been disturbed by ploughing and other cultivation work. Wire gauze should be placed over the windows of the packing shed, and shallow troughs placed in front of the windows in which to trap moths with a lure at the time of their emergence.

It is now late to spray peach and cherry trees with tar distillate for aphis; if this work has not

[Continued on page 416.

Grain Crops

World Production and Trade

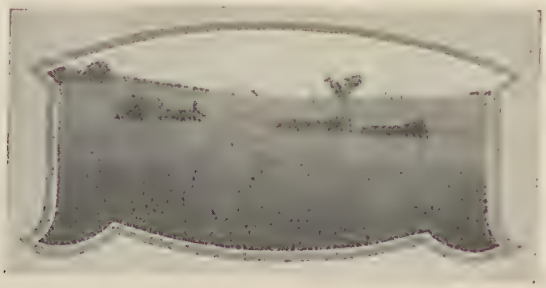
THE notable rise in wheat prices during the current season has excited public interest. A review of "Grain Crops," which the Imperial Economic Committee has just issued,* appears therefore at an opportune moment, and provides a handy summary of the underlying statistical position of wheat production, trade, and stocks.

The review shows how three successive years of small crops in North America and the small 1935-36 crop in Argentina have facilitated the liquidation of stocks, which for years have continually overhung the wheat market. World stocks fell from 31,000,000 tons on 1st August, 1934, to 19,000,000 tons at the same date last year. By 1st August this year they are expected to total less than 14,000,000 tons. The fall in stocks expected this season follows on the drought in North America last summer and the poor crop reaped in most countries of Western Europe, which have consequently been buying larger quantities from overseas. In the United States itself, an important change has come about; normally an exporter of wheat, that country has been a net importer during the past two years.

In describing this improvement in the statistical position of the wheat trade, which must be witnessed with gratification by all overseas producers, the review draws attention to several factors which may adversely affect the position in the future. In the first place, the higher price has already encouraged growers in Europe and North America to devote a larger area to the cultivation of wheat, and, given normal weather conditions, larger crops may, therefore, be expected this season. And, secondly, European countries have as yet shown no inclination to make any permanent change in their policy of reducing their dependence on foreign sources of supply, a policy which has in recent years achieved a considerable degree of success. The six leading importing countries of the Continent reduced their net imports of wheat and flour between 1930 and 1936 by more than one-half. Unless the European countries are prepared permanently to reverse the restrictive policies towards imports which they have adopted to stimulate and maintain their grain production, or unless the wheat acreage in the exporting countries is reduced, it seems likely that a series of good harvests might soon create as difficult a situation as that prevailing a few years ago.

The Imperial Economic Committee's review, which covers the period 1929 to 1936, deals also with barley, oats, maize, and rice. There are special sections relating to the net trade position of the Empire, the imports into the United Kingdom, and the trend of prices since the beginning of 1929.

*Obtainable from H.M. Stationery Office, London (2s. 6d. net or 2s. 8d. post free, plus exchange).



Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

Citrus Red Scale

Progress Report on Investigations, 1935-6

By K. M. Ward, M.Agr.Sc., and C. J. R. Johnston, B.Agr.Sc.

RED Scale (*Aonidiella aurantii* Mask.) causes such serious injury to *Citrus* in Victoria that it constitutes the major biological problem of the industry. While this insect is present in all Victorian citrus areas, the warm dry climate of the northern citrus districts of this State provides very favourable conditions for its rapid growth and multiplication.

The economic loss which results from the insect's presence is considerable. Red Scale infests all above-ground parts of citrus trees, and by extracting sap it quickly reduces them to an unhealthy, weakened condition, and may even cause extensive defoliation and the death of shoots and branches. A more direct type of loss is caused by those scales infesting the fruit. Since infested fruit is not allowed to be sold the practice has arisen of cleaning it by brushing and, more recently, by washing with a strong jet of water applied at a pressure of about 400 lb. per square inch. Both of these processes injure the rind and facilitate the entry of mould fungi, thus destroying the keeping quality of the fruit. In washing, the strong jet of water necessary to remove live scales causes such injury that the appearance of the fruit is often spoiled and its market value considerably reduced.

Control measures adopted by citrus growers in Victoria have given variable and often unsatisfactory results. With regard to spraying oils, it has been claimed that some types or brands of oils were less effective than others, and moreover, no information has been available as to the time of the year that the most effective results from oil spraying can be expected, nor to the optimum strength of the spray mixture.

In the field of fumigation with hydrocyanic acid gas (HCN) the same variation in effectiveness has arisen, and here again data have been lacking on the timing of fumigation treatment, and on other important points. One of the important methods of controlling the insect in other citrus areas of the world, namely by the use of liquid hydrocyanic acid gas, applied with an efficient atomizing pump, has not been tested here. Much information on the life-history and seasonal activities of red scale is required to form a sound basis for the control of the insect.

With a view to determining the factors on which the consistent control of red scale depended, the Department of Agriculture in 1935 initiated a programme of work designed to obtain precise local information on the life cycle of the insect and its control by spraying and fumigation. The present progress report covers the work conducted from April, 1935, to October, 1936.

Research on red scale control in other citrus areas of the world has been very extensive. The work cannot be reviewed here, but an examination of some of the more recent literature will show the general trend of the work against this insect.

The biology of red scale varies in different parts of the world, but most investigators agree in showing the insect to be viviparous, i.e., the young are born alive, no eggs being laid. An exception, however, comes from Palestine (1) (6) where workers have observed that red scales in that country produce eggs which hatch beneath the parent scale covering, the young emerging in one-half to two days.

Spraying for the control of red scale in recent years has been confined almost entirely to oil preparations. Lime sulphur alone (23) and combined with oil (21) has been used and discarded in favour of highly refined or white oils. The addition to spraying oils of toxic substances such as pyrethrum and nicotine has given disappointing results in California (17).

Much work has been devoted to defining the most dependable type of oil and spray-mixture,

having regard to scale killing efficiency and to freedom from properties injurious to the trees. The main points on which workers agree are as follow:—(I) The insecticidal effectiveness of oils depends on their physical properties rather than on inherent toxicity (5) (16). (II) Oils of high viscosity, i.e., heavy types, give better kills than light oils of lower viscosity (5), (6), (16). (III) Insect kill is increased by increasing the oil concentration of the spray applied (17). (IV.) Excessive amounts of spreader and/or emulsifier in sprays cause decrease of kill (4), (22) and lessen liability to injury (5), (17). (V.) The liability to cause injury to trees in leaf is greatest with oils having the highest percentage of unsaturated and aromatic hydrocarbons, and with oils of highest viscosity (8), (5), (15).

American experience has led to the recommendation that nothing heavier than medium grade oil 70 to 80 seconds viscosity (Saybolt) should be used on orange trees (17) while refining of the oil should not leave more than 8 per cent. of impurities, i.e., a balance of 92 per cent. unsuphonatable residue. For lemons, however, which are generally more tolerant of insecticidal treatment, heavy oil of 90 to 105 seconds viscosity (Saybolt) and with an unsulphonatable residue of not less than 95 per cent. may be used. The highly refined white oils now usually employed seldom cause tree injury. It is well known, however, that trees in unhealthy condition from any cause at all are much more susceptible to injury from insecticidal treatments than are normally healthy ones.

Commercial oil spray preparations are broadly of two types:—

(*a*) Stock emulsions containing approximately 80 per cent. of oil and the balance of water and emulsifier, the whole forming a "cream."

(*b*) "Miscible" and "soluble" oils prepared by incorporating with the oil emulsifying ingredients which do not change the appearance of the oil until water is added. The amount of emulsifier present varies considerably with the preparation, varying from a minimum of approximately 1 per cent. to a maximum of approximately 18 per cent. The amount of water present is negligible. Emulsification is then readily effected by steady stirring. An improved type of "soluble" oil preparation containing glycerides of fatty acids is said to be gaining popularity (9), (21).

Oil spray mixtures have been classed as stable or "tight" and unstable or "quick-breaking" (24). With stable emulsions the emulsifying agent is of such a nature and present in such a quantity as to keep the oil globules in a very fine state of subdivision. With the "quick-breaking" types the emulsifier used produces oil globules of larger and more irregular size which separate from water more quickly on the leaf than do small globules. A second type of "quick-breaking" spray, the tank-mixture (17), is made by omitting all emulsifier, mechanical agitation alone producing a thorough mixture of oil and water. Blood-albumen-spreader is added however to facilitate wetting and coverage of leaf and twig.

In recent years, a "quick-breaking" emulsion has been considered desirable in California largely from the point of view of economy because this type deposits a large proportion of its oil on the tree. From the point of view of tree injury, the use of a reliable emulsion is safer than the use of the mechanical "tank mixture."

An important point mentioned in favour of oils is that young scales produced by females surviving an oil spray treatment are unable to settle on the oil-coated surface (21).

Fumigation of citrus trees with hydrocyanic acid gas (HCN) is a generally accepted method, no other fumigant suited to field practice having been discovered (2). The greatest advance in tree fumigation has been the discarding of the pot method which used sulphuric acid, water and sodium cyanide, in favour of the following alternatives:—

(*a*) Generation of HCN from the above ingredients in a portable machine, the liberated gas being blown under the tent;

(*b*) Generation of HCN from calcium cyanide. In this method, calcium cyanide in dust or briquette form is blown under the tent (after grinding in the case of briquettes), HCN being liberated as the calcium cyanide reacts with atmospheric moisture.

(*c*) Generation of HCN from liquid hydrocyanic acid. This liquid is supplied in a steel cylinder and applied to the tree through a convenient pump which draws and accurately measures the dose, atomizing the liquid as it is discharged beneath the tent.

(*d*) Generation of HCN by a variation of (*c*). In this method, a portable machine discharges the gas dosage to the tree, the liquid being vaporized by passing through a heating coil.

The use of liquid hydrocyanic acid is very popular in California at the present time.

A development in fumigation has been the treatment of citrus trees in winter (usually after harvest). Here liquid HCN, in particular, is being used because of its effectiveness at low temperatures. Winter fumigation, it is claimed, allows the use of higher doses of HCN and at the same time causes less injury to the trees (10). Where the relative humidity is below 50 per cent. during winter fumigation, poorer "kills" often result, but if a "diffuser" is used the kill is independent of humidity. Daylight fumigation is also being investigated, notably in California.

Experiments are being conducted also on the use of "tent forms," which hold the fumigation sheet away from the outsides of the tree, because it has been found that the HCN concentration and the insect kill at the periphery of the tree have been lower than at other parts (21), (19).

Probably the most effective control of red scale is obtained by employing a combination treatment involving both spraying and fumigation. The treatment is employed particularly where infestation is severe. It has been shown that oil spray gives a superior kill on leaves and fruit, while fumigation gives the best kill on the wood (21), and therefore these treatments are largely complementary. The most general practice has been the application of a spray first, followed, within ten to fourteen days, by fumigation. It is claimed that the oil loosens the scale covering, allowing the HCN to reach the insect more easily; also that the oil protects the tree against HCN injury (18). A popular practice in California is oil spraying in summer followed by fumigation in the following winter.

Amongst Australian workers on red scale control, Provan (12) has given an account of fumigation in Victoria. In Queensland, Summerville (18) has studied the biology and control of the insect and shown its greater importance and difficulty of control in the drier districts. He claims that judicious use of fertilizers and sound cultural practice maintaining healthy vigorous trees may often sufficiently control the red scale pest in the humid districts. In New South Wales, Hely (15), Arthur and Harrison (14), Woodhill (11), and others have carried out experimental work on spraying and fumigation. Again the red scale pest is shown to be of less importance than other insects in the humid coastal districts, but is a more serious pest in districts of lower rainfall such as the Murrumbidgee Irrigation Area.

Fig. 1.—Type of sweet orange seedling on which red scales were reared.

Victorian Investigations.

For the purpose of investigation, the red scale problem in Victoria has been divided into three main sections—A. Life-history studies of red scale in the field and the insectary; B. Laboratory and field trials with white spraying oils; and C. Field trials on fumigation. The technique employed in these studies is set out below.

A. Life-history studies were carried out with red scale insects reared on potted sweet orange seedlings. (Fig. 1). Oranges infected with red scale were incubated at 82 deg. F., at which temperature the females reproduced prolifically. As larvae were produced they were transferred by brush to the seedlings, where they readily became established. A total of 9,800 were transferred in this way.

As the insects developed, groups of them were daily removed and mounted on microscope slides in de Faure's fluid. These were examined microscopically for changes in morphological characters, &c. When the female scales reached the adult stage a number of them was isolated in cellophane envelopes, and rates of reproduction were recorded.

A large proportion of the insects was allowed to develop and reproduce on 40 trees throughout the summer to provide a stock of insects for the biological testing of various spraying oils. Some 2,000 to 3,000 scales developed on each tree.

In the field-studies on life-history, detailed observations were made on a group of twelve trees at Bamawm. From these, samples of the red scale population on eight fruits and eight twigs from each tree were taken regularly throughout the year. These samples were examined microscopically at Burnley. In all 74,400 insects were examined in making these observations. In addition, general field observations on seasonal activities were made at Bamawm and Mildura.

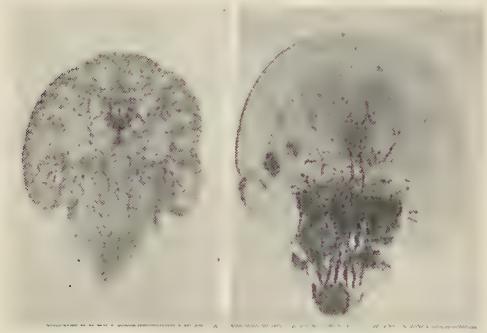


Fig. 2.—Left, Live scale; Right, showing discolouration of body after death. (Magnified 26 times).

B. Trials with white oils.—In *laboratory tests* six different brands commonly used in red scale control were selected at random and employed against scales on potted seedlings. These brands comprised two distinct types of oil, four of them being "oil emulsions" and two being "miscible oils." In one group of experiments these oils were all applied at a common strength of 1·25 per cent., and in a second group one of them was applied at strengths ranging from 1·25 per cent. to 3·0 per cent.

Two trees only could be made available for each treatment, and thus 4,000 to 6,000 scales were treated with each spray. From these, samples of the population were taken, four weeks after spraying, for the mortality determinations. Just prior to applying the sprays the natural mortality occurring on each tree was determined, and in the final calculation of the mortality produced by the sprays, allowance was made on each tree for those which had died from natural causes (see formula below).

As a preliminary to the *field trials*, an examination was made of samples of the red scale population from 48 trees on the experimental site, the object being to determine, for each tree, the percentage of insects dying from natural causes, and the numbers of insects it was necessary to examine to obtain reasonably reliable results. The main points emerging from this statistical survey, were as follow :—

(i) Over the whole block of trees there was a natural mortality gradient from one end to the other.

(ii) The variation in mortality between different trees was greater than the variation between different twigs taken from a variety of positions on any one tree.

(iii) Each of any control treatments applied to such trees required to be replicated eight times on single-tree plots to demonstrate differences of less than 10 per cent. in mortality.

(iv) Samples consisting of eight twigs with three scale-infested leaves on each taken at random from a tree, and an examination of a group of 20 to 30 scales on each leaf were adequate.

This statistical analysis formed the basis for the method of sampling and laying out of plots in the field trials. In addition, the analysis showed that, just prior to the application of the various treatments, a high proportion of the insects was already dead from natural causes, and therefore

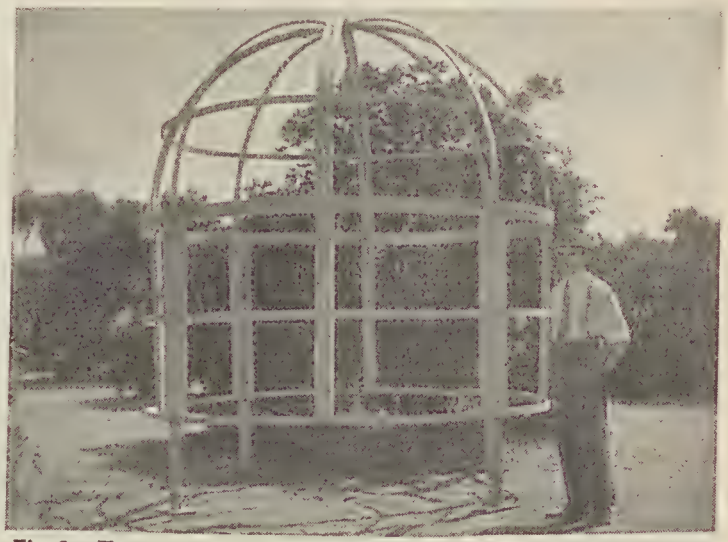


Fig. 3.—Tent form showing extensible legs. To transfer a form it is separated into halves vertically and carried to the next tree.

Fig. 4.—Illustrating method of sampling hydrocyanic acid gas under fumigation sheets.

it was obviously essential to make allowance for this when the final per cent. kill caused by each treatment was being arrived at. The "kill" or per cent. control due to a treatment on any particular plot was calculated from the formula $\frac{a-b}{a} \times 100$, where a = percentage of scales alive before treatment, and b = percentage alive after treatment. Allowance for natural mortality was made on each experimental tree.

In determining the results of treatments the effects produced on the insects on both leaves and fruit were considered. All samples were examined at the Plant Research Laboratory, Burnley, under binocular microscopes, each scale being examined with the aid of a fine needle. Records were made of the stage of growth of the insect (instar). its sex and whether alive or dead. The death of the insect was determined by the development of discolouration within its body (Fig. 2), and/or by the extent of its drying up. After an examination of some 400,000 scales by the writers they feel that the method is reliable.

In fumigation experiments the same general technique was adopted, except that treatments were replicated six times instead of eight as in the spraying trials. The fumigation sheets, which were octagonal and made of 10-ounce duck, were supported over the trees by special frames or tent forms (Fig. 3), which fixed the volume under each tree and in certain respects simplified the experimental procedure.

The approximate behaviour of the HCN under the tents with respect to concentration reached and rates of leakage was studied by making chemical measurements of the gas concentration during the experiments (Fig. 4). This section of the work was carried out by the Agricultural Research Chemist and his staff. Samples of the gas were withdrawn from under the tents (by aspiration) at regular intervals after applying the HCN, and were absorbed in a solution of potassium bicarbonate. The amount of gas absorbed at each sampling was determined by titrating with iodine solution.

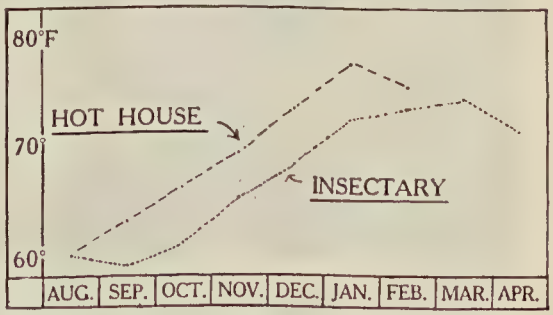
The samples were taken from three positions under the tent, viz., top, bottom and centre along the vertical axis. Actually this part of the work showed only the general tendencies of the gas behaviour, and for more accurate work of this nature certain modifications in technique appear to be necessary. Mean gas concentrations were calculated from the formula :—$MC = \frac{\Sigma mc \times t}{\Sigma t}$ where mc = mean concentration for each time interval and t = time interval over which mc was calculated (7).

RESULTS OF TESTS.

Observations on Life History.

INSECTARY STUDIES.

Establishment of Larvae.—Larvae ("crawlers") born within the previous 24 hours usually moved around for only a few hours after being placed on the leaves of young trees. As many as 50 per cent. established themselves in a fixed position within the first hour; only a few individuals were still moving about 24 hours later. Soon after settling, the larva begins to secrete a waxy covering over itself. At first the covering is white,



Graph 1.—Monthly mean temperatures during rearing of red scale at Burnley, 1935-36.

but within a day or two becomes greyish. Observations on 4,465 insects showed that 57 per cent. of those transferred became established. In transferring the larvae only those which readily moved away from the spot where they were placed were left on the trees.

Rate of Development.—Observations on the rate of development of 650 insects are summarized in the accompanying table :—

	Establishment to First Moult. (Days).	Establishment to Second Moult. (Days).	Establishment to Reproduction. (Days).
Average 16 ..		35	69
Range 12 to 23 ..		29 to 40	63 to 80

These figures indicate that under the conditions in which they were reared (see graph 1) red scale females developed slowly from birth to the reproductive stage. It will be noted that an average of 34 days elapsed between the completion of the final (second) moult and the production of the first young. The development of the male occupied an average of 38 days and involved an extra instar.

General observations made between August, 1935, and March, 1936, showed how the rate of development increased as weather conditions became warmer :—

Mean Daily Temperature. °F	Establishment to Production of First Young. (Days).
64·3	120
71·8	69

Reproduction.—Observations on caged females showed that the daily number of young produced may vary from 0 to 11 and that the reproductive period may extend over 60 days. Up to 145 larvae were produced by individual females. Reproduction is apparently viviparous, no eggs having been observed at any stage.

Distinction between Instars.—First Instar (birth to first moult). The newly emerged larva possesses legs, antennae and eyes (Fig. 5A). These organs are retained only until the first moult, and their presence therefore indicates that the first moult has not occurred. Externally (Fig. 5B,C) the first instar is recognized by the white or greyish colour of the scale covering and by the absence of the first moulted skin in the covering.

Commencement of the first moult is marked by (i) the adherence of the wax covering to the insects' body, and (ii) the outer rim of the wax becoming clear-cut and denser. A microscopic examination of the insect itself shows, (iii) the developing second stage lying in the body of the first, and (iv) the mandibles and maxillae withdrawn and coiled internally on either side of the mouth region. (Thus during moulting the intake of food ceases). After the moult the dorsal cast skin adheres to the wax covering, its outline showing clearly.

Second Instar.—The commencement of the second instar is shown by the extension of the wax rim which is secreted around the margin of the former covering (Fig. 6). The circular shape of the female scale covering (Fig. 7) is maintained by a rotating movement of the body as the wax is secreted. On lifting the covering it is found to be free from the insect (i.e., not adhering).

An examination of the female insect itself shows a change in body shape from oval in the first

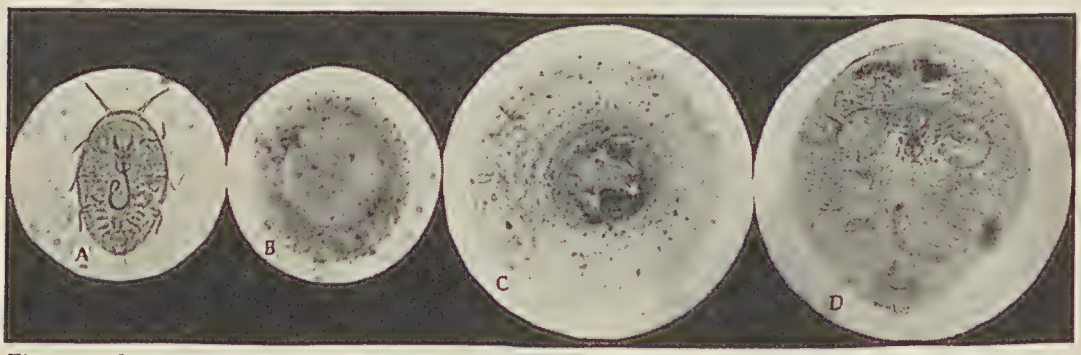


Fig. 5.—Showing stages in development of the red scale larva (magnified 75 times). A, First instar larva ("crawler"). Note legs, antennae, and looped mouth parts. B, Scale covering of larva, established three days. C, Established eight days. D, First instar larva attached to its wax cover for the moult period, established sixteen days. Note the mouth parts withdrawn and coiled at sides.

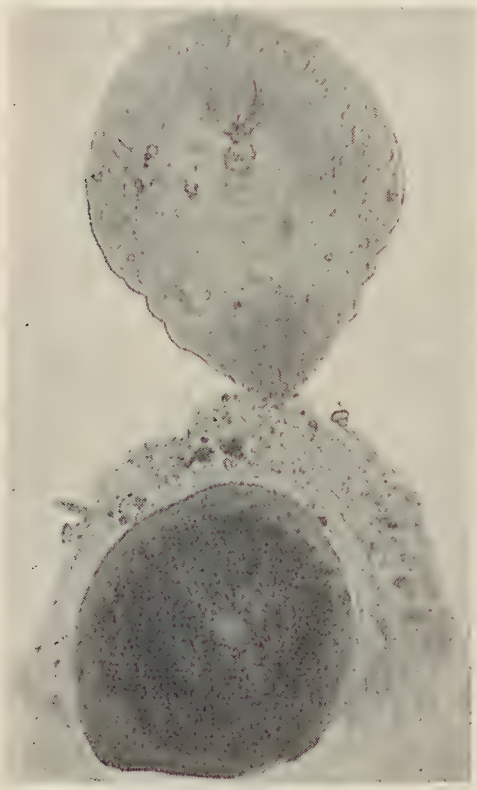


Fig. 6.—Second instar insect (established 20 days) and its covering, showing some extension of wax rim surrounding and attached to the dorsal half of the exuviae (cast skin). (Magnified 110 times.)

instar to pear-shaped in the second. Further, the legs, antennae and eyes are absent, having been shed with the first cast skin.

Towards the end of the second instar the insect again adheres dorsally to the wax covering and the outer rim of wax becomes clear-cut and denser. Coiled mouth parts are again evident (Fig. 8) and on the completion of the moult the dorsal cast skin adheres to the wax covering. This second skin is clearly defined and distinguishable from the first, which lies within its circumference (Fig. 10).

In this instar, differentiation between male and female occurs. The male is more slender than the female and elongation of the wax covering of the male takes place, due to cessation of the rotational body movement (Fig. 9).

Third Instar.—Adult female. After the second moult and prior to fertilization further extension of the wax rim takes place together with the rotation of the insect's body (Fig. 10). This stage is distinguished by the wax covering not being firmly attached to the insect, the appearance of a new wax rim, and the development of lateral thoracic lobes on the insect itself. (Fig. 11)

After fertilization by the male, the covering adheres firmly to the body of the female, rotation of the body ceases, no further extension of the

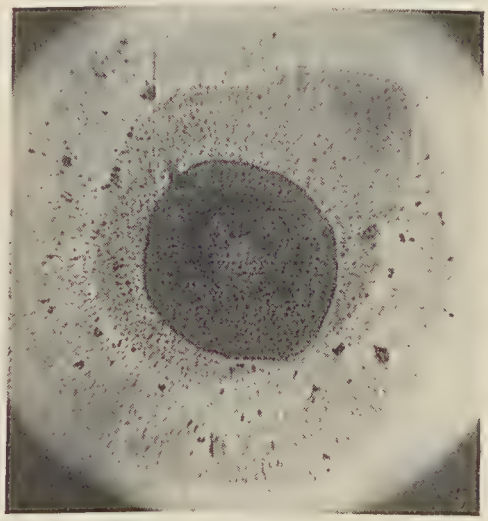


Fig. 7.—Second instar insect (at 26 days) showing full extension of wax rim before second moult. (Magnified 75 times.)

wax rim takes place, the thoracic lobes extend backward on each side of the insect until finally they project beyond the extremity of the abdomen, giving the body a reniform shape (Fig. 12).

Male Insect.—In the third instar or prepupal stage the development of legs, antennae, and

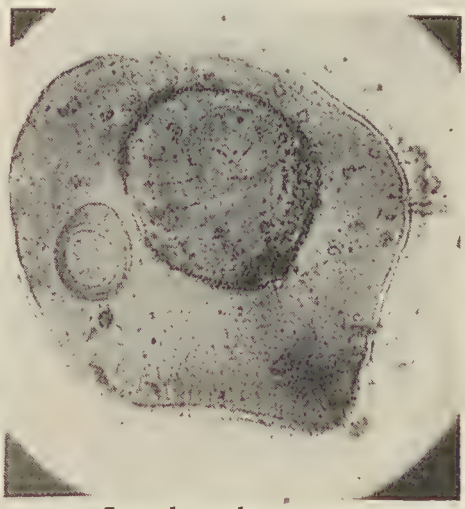
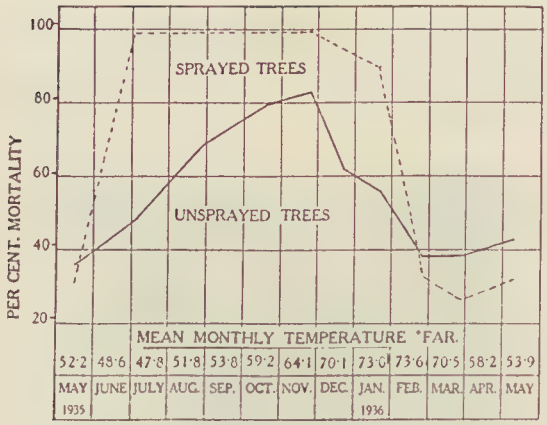


Fig. 8.—Second moult stage (at 39 days) showing coiled mouth parts as in Fig. 5 D. (Magnified 72 times.)


PER CENT. MORTALITY
100
80
60
40
20
SPRAYED TREES
UNSPRAYED TREES
MEAN MONTHLY TEMPERATURE °FAR.
52·2 48·6 47·8 51·8 53·8 59·2 64·1 70·1 73·0 73·6 70·5 58·2 53·9
MAY 1935 JUNE JULY AUG. SEP. OCT. NOV. DEC. JAN. 1936 FEB. MAR. APR. MAY

Graph 2.—Seasonal variation in the natural mortality of red scale at Bamawm, 1935-36.

eyes is fairly clearly marked. The male passes into the pupal stage in which the joints of the appendages and the eyes become clear cut. A final moult produces the fully developed male, which emerges from the scale covering and finally takes to flight (Fig. 13).

Field Studies.

Seasonal Natural Mortality.—Graph 2 shows the percentage of dead red scale insects occurring throughout the year on unsprayed orange trees at Bamawm. Superimposed on this graph is another showing results of similar observations on trees which were sprayed at the commencement of the period.

It can be seen from the graph that the natural mortality fluctuates very markedly throughout the year. After autumn the numbers of dead insects occurring on the trees increase rapidly through the winter and spring and reach a peak in November at the surprisingly high figure of 83 per cent. During the period May to November no young scales were produced. After November, when reproduction begins again, the percentage mortality falls rapidly. Even during the active period of reproduction (November to May) the percentage of dead insects does not fall below 35 per cent. (average). This graph serves to emphasize the prime importance, when investigating control measures, of making allowance for the numbers of insects already dead from natural causes.

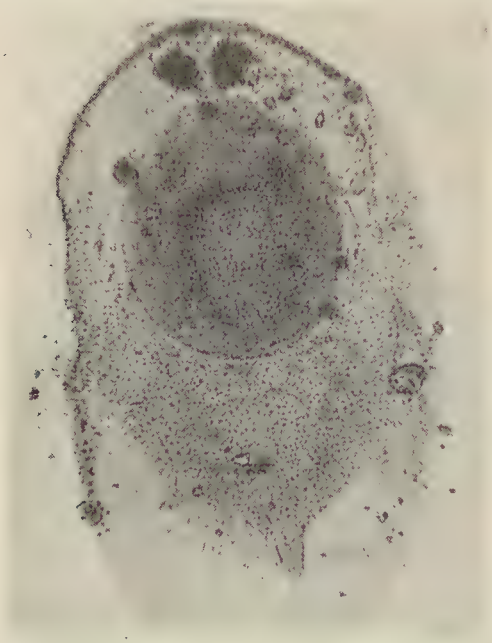


Fig. 9.—Male insect seen beneath its elongated scale covering—40 days from establishment of the larva. (Magnified 86 times.)

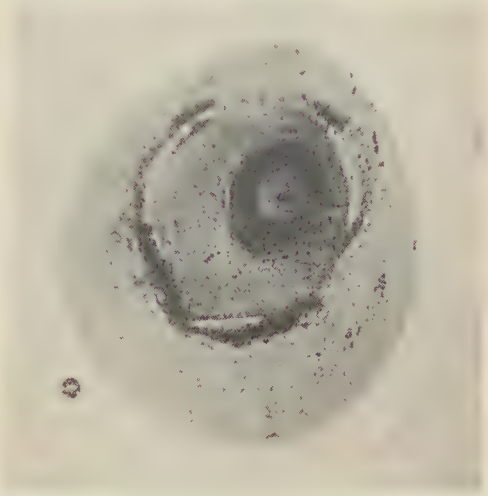


Fig. 10.—Scale covering of adult female (at 43 days) showing cast skins of first and second moults and full extension of wax rim. (Magnified 36 times.)

Doubtless the percentage of scales dying throughout the year will vary in different years due to climatic influences, but it is reasonable to expect the peak in the natural mortality to occur just prior to the recommencement of reproduction each year, because of the death through the winter of many of the old females and their non-replacement by young scales. The occurrence of this high peak of natural mortality is regarded as being of importance in relation to the timing of control measures.

Referring again to Graph 2 it will be seen that five to six weeks after some of the trees had been sprayed in May, 98·7 per cent. of the scales on the trees were dead, and this figure is practically constant through the winter. The survivors of the spray treatment begin to reproduce in November, and so the percentage dead decreases until the figures on sprayed and unsprayed trees are comparable. Of course, the spraying reduced the degree of infestation considerably and this cannot be shown on the graph.

Graph 3 shows the percentage of each instar of the insect found dead from natural causes on the date shown at the foot of the columns. During

Fig. 11.—A fully developed adult female (at 43 days), about 30 days before reproduction commences. Note looped mouth parts formed into a tube before complete penetration into plant tissue. (Mag. 52 times.)

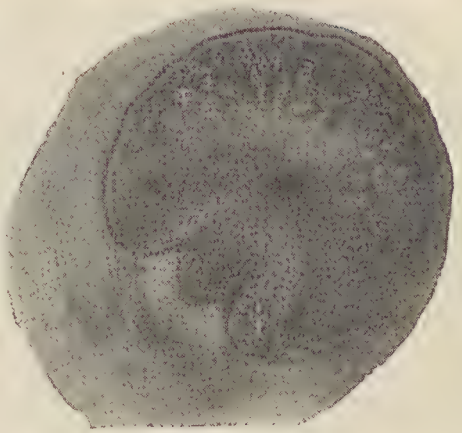
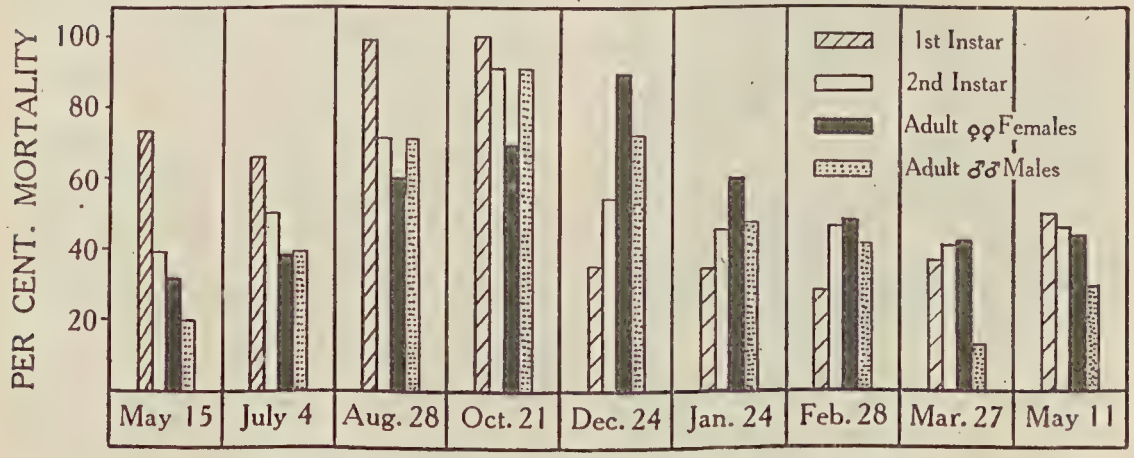


Fig. 12.—Female at reproducing stage. (Mag. 35 times.)

the *non-reproductive period* (May to November), there is a general increase in mortality in all stages of the insect. All first instar forms either die or transform to the second instar. The lowest mortality occurs among the adult females. During the *reproductive period* (November to May) the highest mortality is among the adult females, while the immature stages show a decrease in mortality.

Seasonal Proportion of Each Instar.—Graph 4 shows the relative proportions of the immature and adult stages of the insect. It is evident that *first stage forms* are very low in number between May and November, and are actually absent from the trees during August, September, and October. During the reproductive period, beginning in November, the proportion of this stage rapidly increases to a peak in December and to a further peak in March.



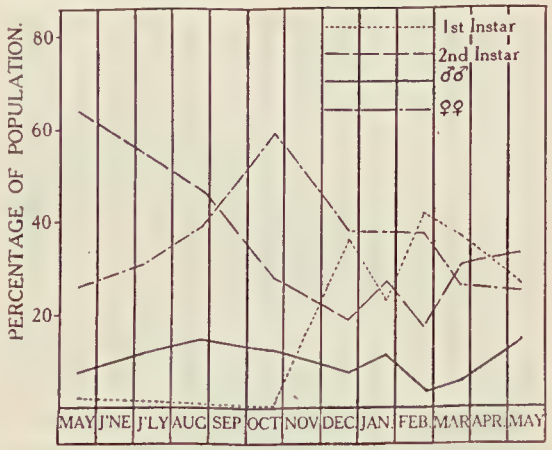
Graph 3.—Showing seasonal natural mortality in each instar.

It is considered that the low proportion of first stage forms present in January is due chiefly to the cool moist weather conditions prevailing prior to sampling for that month's determinations.

Taking *second stage forms*, the proportion is high in May, but it falls consistently through the winter. This fall coincides with a rise in the proportion of adult females, indicating that many of the second stage forms develop into adults during that time. The fall is also partly due to the relatively higher death rate amongst second-stage forms. It will be noted that a similar inverse relation exists between the relative proportions of the first and second stages; thus when one reaches a peak the other falls to a trough. This is merely an expression of the development of one stage into a later stage.

The proportion of *adult females* increases markedly throughout the winter, due largely to the development of second stage insects into adults. During the period September to November adult females predominate over other stages.

Fig. 13.—Male adult insects. Below, Showing wings and antennae. (Mag. 15 times.) Above, Mag. 66 times, showing structural details. Mouth parts are absent—the adult male does not take food.



Graph 4.—Seasonal variation in the proportions of the various stages comprising the red scale population, Bamawm, 1935-36.

The proportion of *male insects* fluctuates throughout the year, varying between 4 and 15 per cent.

In general, notable points emerging from the facts presented in Graph 4 are (i) there is a quiescent period between May and November during which reproduction does not take place and the adult female gradually becomes the predominating stage, and (ii) during the same period there is a development of second stage scales into adults showing that feeding on the trees is continuous. During the most active period (November to May) immature forms tend slightly to predominate over adults.

Discussion on Life-History.

Observations in the Bamawm and Mildura districts show that the life-history of red scale is very similar in each, with the exception that owing to a somewhat higher average mean temperature at Mildura, the period suitable for reproduction there is slightly longer at each end of the season than at Bamawm.

Female scale insects which have developed during the winter or have overwintered as adults begin to produce young scales during the third to fourth week of November. They are apparently born alive, no egg stage having been observed in Victoria. The larvae develop to maturity rather slowly, the period elapsing between their birth and the first reproduction being from 9 to 20 weeks, according to the time of the year. Before the females begin to reproduce they are fertilized by the males which become winged and leave the shelter of their scale covering for that purpose. Females may continue to produce young for

eight weeks or more. Each may give birth in that time to as many as 145 larvae. This high reproductive rate over a relatively long period compensates for the slow development of the insects to maturity, and explains the rapid and enormous increase in the red scale population at certain times of the year. The insect becomes established on all above-ground parts of the tree, including leaves, fruit, twigs, main branches and trunk. Furthermore, there is a very large number of alternate host plants, including many common orchard weeds, garden plants, trees, and even date palms.

There are two complete generations and a partial third during the November to May period, the third generation probably attaining only small proportions at Bamawm. These generations are not clear-cut, as young are produced continuously, but the first generation extends approximately over the period November to February, and the second February to May. With the approach of winter reproduction ceases, but scales produced just prior to winter either die (due to the influence of the winter climate) or slowly develop through winter and spring into adults which reproduce in the following summer.

Control Measures.

Trials with Spraying Oils.

As a first step in the biological standardization of white oil for red scale control, it was decided to test six brands of white oil in both laboratory and field trials, and, as far as possible, to correlate insect mortality with the characteristics of the oils. Later steps were to include the testing of various oil sprays prepared according to definite specifications such as might be indicated by the results of these trials.

Laboratory Tests.—The six oil spray treatments comprised four commercial brands which can be grouped under the heading of "stock emulsions," and two which fall into the "miscible oil" group. The main distinction between these two groups lies in their method of emulsification, and the appearance of the concentrated material. In the former the emulsifying agent is usually dissolved in water, and the concentrated emulsion appears as a white paste; in the latter group the emulsifying agent is usually dissolved in oil and the concentrated material appears as a clear oily fluid. Both these types of preparations readily mix with water to form the well known white oil spray mixture.

From a statistical examination of the results of the laboratory spraying tests, no definite conclusions could be drawn, although there were indications that inferior control was likely to be obtained from the use of miscible oils when applied at the same concentrations as the emulsions.

Field Trials—Types of Oil (Brands).—The six brands of oil used in the laboratory tests (and taken from the same containers) were employed in the field trials. The different treatments were applied on replicated plots on the Valencia orange grove of Mr. B. Mew, Bamawm. The sprays were applied in autumn at a strength of 2·5 per cent. (which was equal to or greater than the recommended strength). Four weeks after spraying, samples of scale-infested twigs and fruit were taken from the trees for mortality determination. A total of 176,761 insects was involved in the determinations before and after spraying. Final results are set out in Table I.

Table I.—Results of Field Trials Showing Control Given by Typical White Oils when Used against Red Scale, Bamawm, 2·5 per cent. Spray applied 26th April, 1935.

Treatment.		Control.
		%
I.	Emulsions	98·5
II.		98·6
III.		98·9
IV.		99·5
V.	Miscible oils	97·8
VI.		96·9
	Standard error	0·6
	Average natural mortality	30·2

The figures in Table I. show that all of the brands of oil, both types, caused a relatively high "kill" of insects, and that the differences in the "kill" between the brands are not great. The following significant differences occurred:—Treatment V. gave inferior control to Treatment IV., and Treatment VI. was inferior to I., II., III., and IV. The first four treatments do not show any significant differences between each other, neither do the last two. It is to be noted that in the field trials, as in the laboratory, the differences in control lie between the miscible oils and the oil emulsions.

The insect mortality caused by the sprays, varied much more on the fruit than on the leaves, due largely to the probable incomplete covering of some of the fruit with the spray mixture. Actually, the differences in mortality

caused by the treatments were not significant. Comparing the kill obtained among scales on leaves with that on fruit, the mean kill given by all the treatments was 98·4 per cent. on leaves, while on the fruit it was 96·3 per cent., the difference being significant. Of the total insects found alive on the sprayed trees 96·6 per cent. were adults and 89·6 per cent. were adult females.

The different oils used in this experiment were submitted to a chemical examination at the State Laboratories. Determinations were made on moisture, oil and emulsifier content, specific gravity, viscosity, unsulphonated residue, unsaturated and aromatic content, boiling point range, volatility and colour of separated oil. The detailed results of these analyses have been compared with the results of the various trials, and as these trials showed consistent differences only between the miscible oils and the oil emulsions, the comparison has been made between these two groups.

The analyses showed that the two groups differ from each other in moisture content and the proportion of the emulsifying agent present. The two "miscibles" showed an average of 18·3 per cent. (15·9 and 20·6 per cent.) of emulsifier, and the four "emulsions" 2·7 per cent. (2·2 to 3·3 per cent.). The other properties of the two groups of oils did not differ markedly from each other, and it would seem, therefore, that the different degrees of control given by the two groups are accounted for largely by the difference in the kinds and the proportions of emulsifier present. This observation is in accord with the results of work carried out by de Ong and Knight and others.

Fruit Infestation at Harvest.—Eight months after the trees had been sprayed the fruit crop was harvested, and examined and classified according to the red scale infestation showing on it. Table II. shows the results of this examination. Although the spray killed the scales they did not weather off the fruit in the eight months between spraying and picking.

TABLE II.—PROPORTION OF FRUIT INFESTED BY RED SCALE EIGHT MONTHS AFTER SPRAYING.

Class.	Average Number Scales per Fruit.	Brands Section. Sprayed Trees Percentage each Class.	Control Section.	
			Sprayed Trees Percentage each Class.	Unsprayed Trees Percentage each Class.
Clean ..	0	29·0	44·1	0·5
Light ..	75	53·9	45·7	35·8
Medium ..	329	14·6	9·6	49·3
Heavy ..	805	2·5	0·6	14·1

The outstanding feature of these figures is that, in general, they show the relatively low proportion of scale-free (clean) fruit obtained from sprayed trees eight months after treatment. Much less than half of the fruit on sprayed trees was clean. Comparing the percentage of clean fruit on sprayed and unsprayed trees in the control section it is evident that the spraying has resulted in a much higher proportion of clean fruit, although that amount cannot be regarded as satisfactory. In the "heavy" class the maximum population on some fruits amounted to 1,400 insects.

A second notable point is that on the sprayed fruit at the time of harvesting, 86 per cent. of the insects were dead, while on the unsprayed fruit 56 per cent. were dead. Thus, a high proportion of those insects killed by the spray had not weathered off in the eight months elapsing between spraying and harvesting, and the relatively low percentage of clean fruit from sprayed trees is mainly due to this fact.

The main point emerging as a result of the fruit examination is with reference to the timing of spray treatments. It shows the advantage of spraying at a fairly early stage in the development of the fruit, especially where infestation is heavy. In this experiment the fruit was practically fully grown when the sprays were applied.

Time-of-spraying Trials.—Preliminary trials on time of application of white oil sprays were made at the Navel orange grove of Mr. F. D. Brown, Bamawm. An oil spray (Oil I.) at 2·5 per cent. strength was applied as under :—

(i) Single summer spray applied 18th December.

(ii) Double summer spray applied 18th December and 18th January.

(iii) Summer and autumn spray applied 18th December and 6th May.

(iv) Autumn spray applied 6th May.

The mortality caused among scale on leaves by these treatments is shown in Table III.

It is evident that each treatment gave a high initial kill. In the case of the single summer spray the survivors reproduced throughout the season, so that by 12th June the percentage dead was only 39.5, i.e., comparable with the natural mortality on unsprayed trees (32·1). Four weeks after applying the single summer spray 47 per cent. of the live insects on the trees were in the

SEEDS

RAPE—THE FOOD FOR SHEEP

Easily cultivated, makes strong, rapid growth, and produces an abundance of highly nutritious and palatable green feed which is greatly relished by all kinds of stock. Rape is also an excellent crop for green-manuring and for silage.

We are the Original Introducers of

TRUE GIANT KANGAROO RAPE

Our "Tip-Top" strain of Giant Kangaroo Rape grows to a great height, and will fatten 3 sheep more to the acre than any other kind. The stalks are succulent right through.

DWARF ESSEX RAPE—We import only the true broad-leaved strains, English and Dutch.
Recleaned and free from weeds.

PRICES—True Giant Kangaroo, in 1-cwt. sealed bags, 7½d. lb., 65/4 cwt. Dwarf Essex, English, 6½d. lb., 56/- cwt. Dwarf Essex, Dutch, 6d. lb., 50/- cwt.

PHALARIS TUBEROSA

An excellent Winter and Spring-growing, truly perennial grass, will withstand severe frost as well as drought, and provides three to four cuts of succulent feed per year. Our strain of Phalaris Tuberosa is noted for the abundant bright green leaves, long period of vigorous growth, and large fibrous root system. Sow 3 to 4 lb. per acre.

PRICE—4/6 per lb.

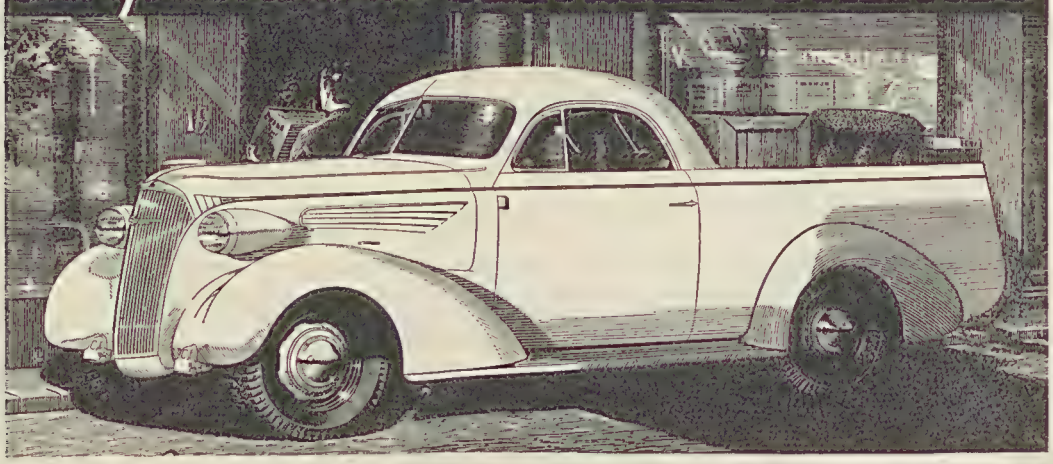
FREIGHT PAID—For cash with order of £2 and over we will pay freight (goods train) to any Station in Victoria, also on Interstate cash orders of £5 and over.

For Perfect Pastures Sow Seed from

LAW SOMNER PTY. LTD.

21-23 ELIZABETH STREET, MELBOURNE, C.1

Cut your costs with CHEVROLET UTILITIES



Smartest in Looks... Smartest in Action

Economy is the keynote of these smart, hard-working 1937 Chevrolet Utilities—economy which will save you pounds in operation. The famous Chevrolet 6-cylinder overhead valve engine is now 10% more efficient and 10% more economical, exceptionally long-lived, and never needs replacing. Frame, brakes, springs, clutch—are all stronger and more capable of performing the hard racketing work which utility operators demand. Every part of Chevrolet is designed for easy access, so that when repairs are needed they may be easily and cheaply carried out. Moreover, spare parts and Chevrolet service are available everywhere.

All the new Chevrolets have All-steel "Turretop" driving compartments, bringing wide visibility in their deep, V-type safety glass windscreens. Comfort, too, in the flat-floored roominess these Chevrolets offer—in their deeply-sprung upholstery and no-draught ventilation. Parcel-shelf at rear of driving seat, a neat glove-box on the dash, and many other improvements, make business a pleasure when you're driving a Chevrolet Full-door Utility. There's plenty of space for loads which pay in the big payload compartments and sufficient rugged body strength to stand up to real hard work.

GENERAL MOTORS-HOLDEN'S LIMITED

CHEVROLET UTILITY FEATURES

Higher Powered, more Economical 6-cyl. O.H.V. Engine, which never needs replacing.

Slipper Skirted Grey Iron Pistons save wear.

Four Bearing Crank and Camshafts for smooth performance

Perfected Hydraulic Brakes—Self-energising and even-wearing.

Forward Engine Position, giving scientific load distribution.

Longer, Stronger Frame adds to chassis life.

Synchro-Mesh Gears (on all models).

Independent Front Wheel Springing (on Master de Luxe).

All-Steel "Turretop" Driving Compartments on all Utilities models.

Full-Length Truck Frames and All-Steel Safety Cabs on Commercials.

Your Money Goes Farther in a General Motors' Product.

FREE: Keep check of your running costs. Send to General Motors-Holden's Ltd., Box 1714, G.P.O., Melbourne, for free copy of Simplified Operating Cost Book.

CONSULT YOUR LOCAL AUTHORIZED CHEVROLET DEALER.

Sold and Serviced by Chevrolet Dealers throughout Australia

CHEVROLET UTILITIES AND COMMERCIALS

ALSO 30 CWT.-2 TON TRUCKS, HEAVY DUTY "MAPLE LEAF" TRUCK

Easy to Buy under Confidential G.M.A.C. Plan of Deferred Payments

TABLE III.—"KILL" OF RED SCALE RESULTING FROM SUMMER AND AUTUMN APPLICATIONS OF A WHITE OIL EMULSION SPRAY, BAMAWM, 1935-6.

Treatment.	Percentage Mortality (four weeks after Final Spraying).	Percentage Mortality (12th June).
Single summer spray ..	97·5	39·5
Double summer spray ..	98·8	69·6
Summer and autumn spray	97·3	88·2
Autumn spray	95·8	95·8
Natural mortality, 18th December ..		54·8
„ „ 12th June ..		32·1
Total scales examined ..		..44,651

first instar, showing that the surviving females had reproduced within a month of the spray application. The autumn spray tended to give an inferior kill compared with the three other treatments.

The main results of the experiment are based on the scale infestation showing on the fruit when harvested on 11th September, 1936. This is shown in Table IV.

TABLE IV.—COMPARISON OF SCALE-FREE AND INFESTED FRUIT PICKED FROM PLOTS SPRAYED IN SUMMER AND AUTUMN, BAMAWM, 1936.

Treatment.	Percentage Heavy-medium (139 to 785 Scales per Fruit).	Percentage Clean.
Single summer spray ..	61·6	10·5
Double summer spray ..	39·6	27·1
Summer and autumn spray	59·9	10·2
Autumn spray	91·5	0·1
Standard error ..	..	2·3

The figures in Table IV. show that there is a marked advantage in applying a double summer spray early in the breeding season of the insect. This treatment has given the highest percentage of clean fruit. The autumn spray alone was ineffective in producing scale-free fruit at harvest, in spite of a 95·8 per cent. kill and the lapse of four months between spraying and harvest. Actually, 85 per cent. of the scales on the fruit in the heavy-medium class were dead, showing that the scales killed by the spray had adhered to the fruit. A summer spray followed by one in autumn was no more effective in producing scale-free fruit than a single summer spray.

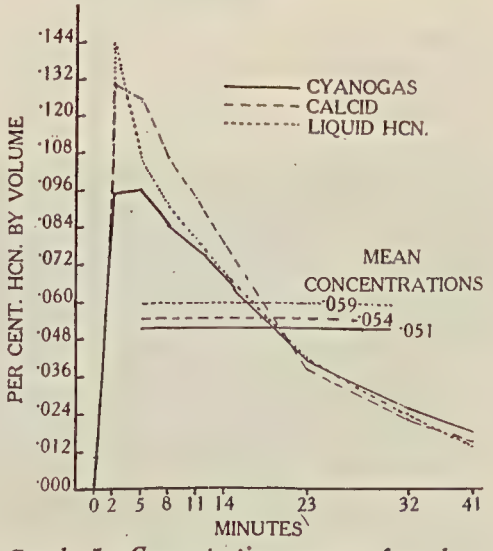
The percentage of scale-free fruit resulting from any of the above treatments is disappointing. It is evident that part of the fruit infestation was built up from the survivors of the treatments. The experiment indicates the desirability of achieving as high an initial kill as possible so that the number of survivors will be reduced to a minimum. Obviously, further work is required before the most effective timing of spray applications can be decided.

Strength of Oil Spray Mixture.—Results of field trials in which Oil I. was used at various strengths are set out in Table V.

TABLE V.—SHOWING MORTALITY CAUSED BY VARIOUS STRENGTHS OF WHITE OIL SPRAY.

Treatment.	Percentage Mortality.	
	On Leaves.	On Fruit.
3 per cent. (1 in 33) ..	99·7	98·0
2·5 per cent. (1 in 40) ..	99·4	98·3
2·0 per cent. (1 in 50) ..	98·4	98·6
1·5 per cent. (1 in 66) ..	98·8	94·1
1·25 per cent. (1 in 80) ..	96·0	94·9
Standard error ..	0·4	0·95

Number of scales examined, 55,467.



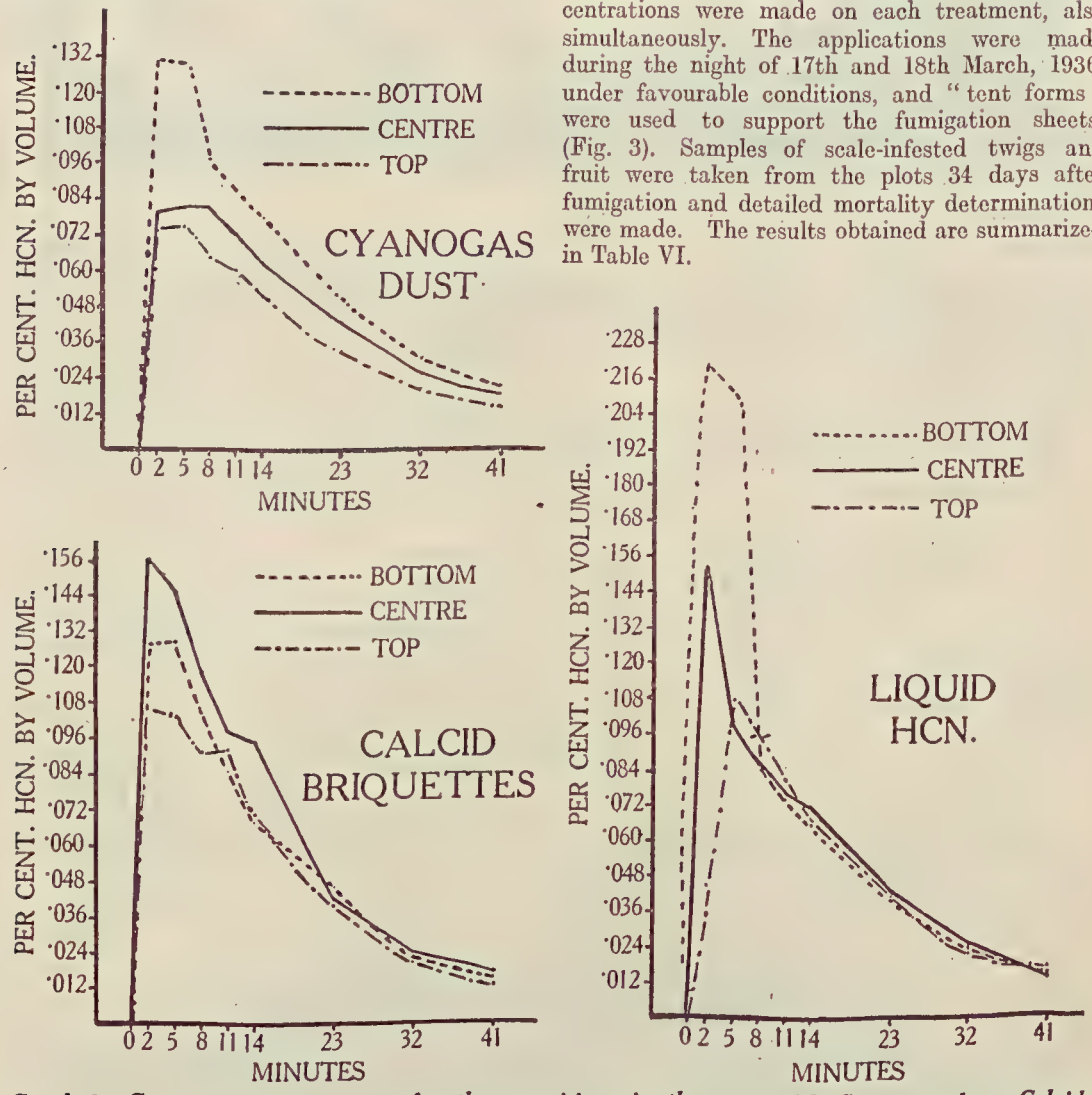
Graph 5.—Concentration curves for three fumigating materials. Average of three tests—Red Cliffs, 1936.

In general, these results show a tendency for the control to decrease as the strength of the spray is weakened, although this decrease is not very great. Strengths of 3 per cent. and 2·5 per cent. have given superior control as compared with the weaker strengths. Increasing the strength of the spray from 2·5 to 3 per cent. has not given any significant improvement in the control obtained. A significantly greater mortality occurred on the leaves than on the fruit, thus supporting a similar observation made previously. Of the survivors of the treatments 86 per cent. were adults, 75·2 per cent. being females.

Field Fumigation Experiments.

Comparison of Three Methods of Generating Hydrocyanic Acid Gas (HCN).—In this experiment the treatments were :—*A* Cyanogas dust, *B* Calcid briquettes, *C* Liquid HCN. The experiment was carried out on the Valencia grove of Mr. K. McCallum at Red Cliffs (Mildura district).

Each of these materials was applied by means of the appropriate machine, and at each "throw" of the tents all treatments were applied simultaneously. The treatments were replicated six times on single tree plots, and in three of the replications chemical measurements of gas concentrations were made on each treatment, also simultaneously. The applications were made during the night of 17th and 18th March, 1936, under favourable conditions, and "tent forms" were used to support the fumigation sheets, (Fig. 3). Samples of scale-infested twigs and fruit were taken from the plots 34 days after fumigation and detailed mortality determinations were made. The results obtained are summarized in Table VI.



Graph 6.—Gas concentration curves for three positions in the tree—with Cyanogas dust, Calcid briquettes, and Liquid HCN. Red Cliffs, 1936.

TABLE VI.—COMPARISON OF THREE METHODS OF GENERATING HCN.

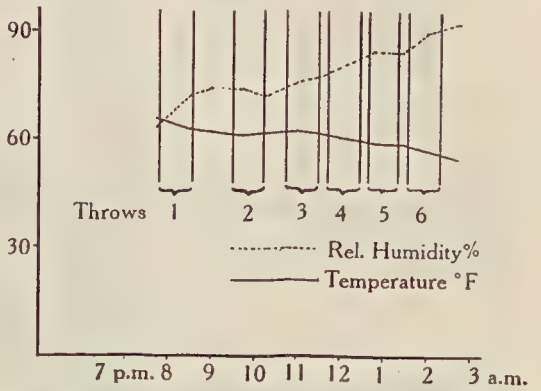
Treatment.	Percentage Mortality.	
	On Leaves.	On Fruit.
A Cyanogas	99·6	99·8
B Calcid briquettes ..	99·4	99·9
C Liquid HCN	99·5	99·8
Standard error ..	0·2	0·1
Average natural mortality	35·5	27·4

Number of scales examined, 49,195.

The standard error figure though low is not small enough to permit of differentiation between these three materials, each of which shows high killing efficiency. Of 26,301 insects examined after fumigation only 70 live individuals were observed. The fact that the liquid HCN proved to be as equally efficient as the other two treatments is of particular interest, in view of the fact that the liquid was transported from the United States of America and then stored at Burnley for three months before being used. The above result indicates that the material had not deteriorated during the period of transport and storage.

The results of the chemical measurements are presented in Graph 5, which shows the average concentration-time curve of the three materials. With each, the maximum concentration of gas is reached rapidly—liquid HCN and Calcid briquettes in two minutes and Cyanogas in two to five minutes. The two dry materials show a tendency to maintain a high concentration for a slightly longer period than the liquid HCN. This tendency is probably attributable to the more gradual liberation of HCN from the "carrier" material, while with the liquid HCN the whole of it vaporizes immediately on being forced into the atmosphere as an atomized spray. At about 22 minutes after application all the materials reached a common concentration, which then fell uniformally till the end of the fumigation period. The mean concentration of HCN given by each of the materials over the 45-minute fumigation period was practically the same.

The mortality figures shown in Table VI. indicate that the different types of gas behaviour shown by the three materials do not confer any great advantage on any particular one of them.



Graph 7.—Meteorological conditions during tests on night of 17th March, 1936.

Graph 6 shows the results of a study of the distribution of the gas at the top, centre, and bottom of the trees. It would appear that the three materials give a slightly different HCN distribution. Thus with liquid HCN and Cyanogas the maximum concentration was reached near the bottom of the tree, while Calcid briquettes tended to show relatively little difference in concentration at the various points.

The meteorological conditions during the experiment are shown in Graph 7.

Dosage Trials.—In another experiment, conducted on the grove of Mr. A. Henshall, Mildura, dosage rates were tested using liquid HCN. The treatments were applied on the

Fig. 14.—Partial defoliation caused by red scale infestation.

night of 19th March, 1936, by which time the fruit was fully grown, and were as follows :—

A Standard dose = four 16 c.c. units per 600 cubic feet.

B Standard dose — 12·5 % = four 14 c.c. units per 600 cubic feet.

C Standard dose + 12·5 % = four 18 c.c. units per 600 cubic feet.

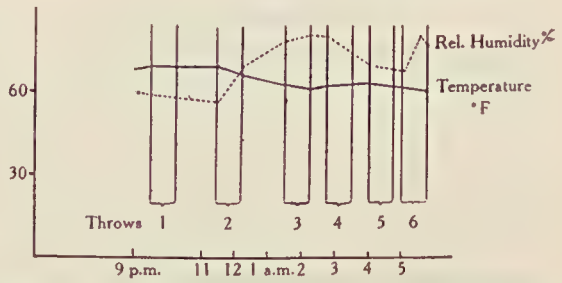
D Standard dose + 37·5 % = four 22 c.c. units per 600 cubic feet.

The insect mortality resulting from these treatments after making allowance for natural mortality is shown in Table VII.

TABLE VII.—HCN DOSAGE TESTS AT MILDURA.

Treatment.	Percentage Mortality.	
	On Leaves.	On Fruit.
A	99·7	99·5
B	99·8	99·6
C	99·8	99·7
D	99·6	99·8
Standard error ..	0·4	0·2
Average natural mortality	33·2	39·3

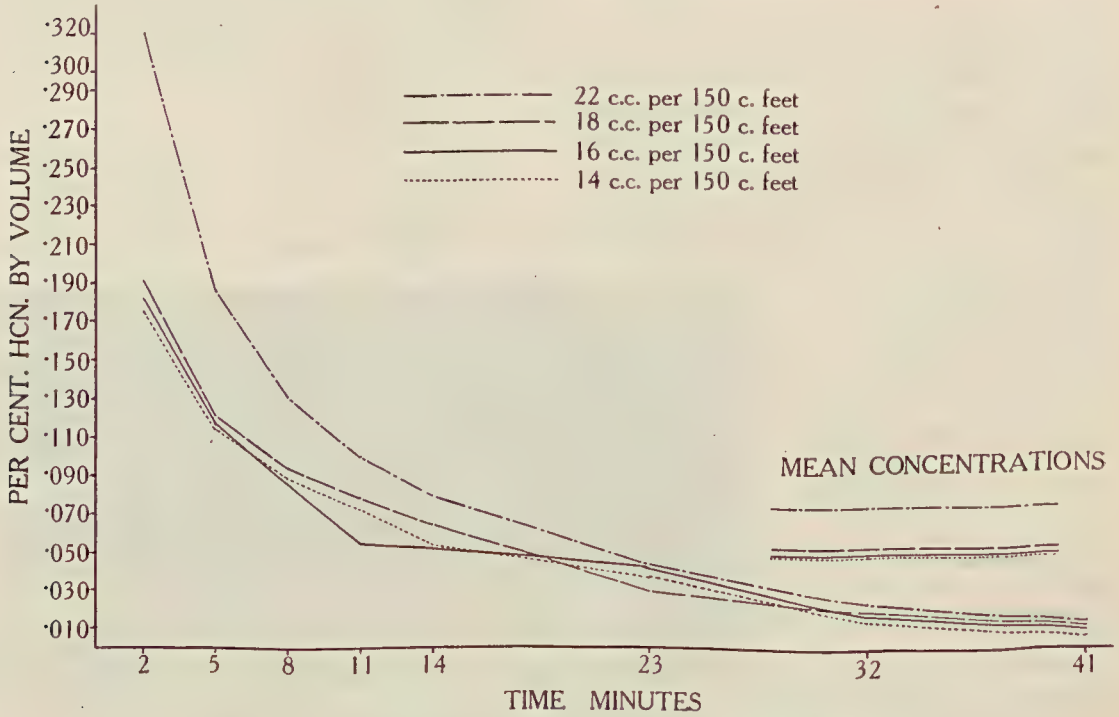
Number of scales examined, 60,778.



Graph 9.—Meterological conditions during dosage tests on night of 19th March, 1936.

The mortality figures again show the efficiency of HCN applied in liquid form. A feature of the results is that while the lowest dosage gave a satisfactory commercial kill, the highest dosage did not give 100 per cent. kill. In Graph 8 the gas concentration built up by each dosage is shown. The mean concentration values at the right of the graph show small differences only between the lower rates, and while the 22 c.c. schedule gave a much higher, though non-significant mean concentration, it did not cause any higher kill.

From a total of 38,255 scales examined after treatment only 103 live individuals were observed,



Graph 8.—Concentration curves for dosage tests—Mildura, 1936.

Fig. 15.—Atomising pump used in applying liquid HCN.

and of these 30·9 per cent. were in the first instar, 26·4 per cent. in the second instar, and 42·7 per cent. were adult females; no live males were observed. These latter figures seem to indicate that the surviving females fully recovered from the treatment, and reproduced within the 33 days between fumigation and the examination of the samples.

Another notable point of the experiment was the degree of tolerance the trees showed to the gas; even under the strongest dosage and in spite of the fact that the trees were in a weakened condition at the time of fumigation, no serious injury resulted. The trees carried a sufficiently severe infestation to cause a fairly heavy leaf fall just before the fumigation treatments (Fig. 14). After the fumigation of these trees wilting of some of the new shoots occurred on all plots, and eventually these shoots died. This type of injury is usually incidental to HCN fumigation, and is not generally regarded as being very harmful to the trees. It is interesting to note that the injury was not more extensive on trees receiving a dosage 37·5 per cent. above the standard.

Meteorological conditions during the experiment are shown in Graph 9. It will be noted that the experiment was carried out under cool conditions (average 59·6 deg. F.).

The crop from the experimental trees was harvested two months after fumigation, and the fruit was separated into four classes, according to the degree of infestation. Results are shown on Table X. From these figures it is seen that on 94·5 per cent. of the fruit the infestation was heavy to medium. This fact is very striking in view of the high mortality produced by the fumigation two months previously (averaged 99·7 per cent.), and it shows that the dead scales had not weathered off the fully grown fruit during this period. This serves to stress the necessity for taking into account not only the killing efficiency of the insecticide to be employed against red scale, but also the proper time for applying the control measures.

Table X.—Red Scale infestation on Fruit harvested from Fumigation Plots at Mildura.

Fumigated on night of 19th March, 1936.

Class.	Number of Insects per Fruit.	Percentage of Each Class.
Heavy	400 to 2,560	74·0
Medium	60 to 400	20·5
Light	1 to 60	4·8
Clean	Nil	0·7

Discussion.

A considerable part of the red scale investigation up to October, 1936, must be regarded as being of a preliminary nature, one of the objects being to determine suitable experimental technique and to obtain a thorough knowledge of the problem. A great part of the work of placing the control of red scale on an improved basis still remains.

In so far as the control of the insect is concerned, one of the main points shown by studies on its seasonal activities is that a high peak of natural mortality occurs during November, just before the reproductive activity of the insect begins. This suggests that the application of efficient control measures at or near this peak may be advantageous. Other considerations are of importance, however, in the timing of control measures.

The spraying trials have indicated the strong tendency for some types of oils (miscible) to give inferior control of the insect, and the reason for this appears to lie, partly at least, in the kind and proportion of the emulsifying agent

present in the oil. Overseas experience has also shown the inferiority of oils containing a relatively high proportion of emulsifier. The work has indicated that up to the present the best spray treatment consists of applying a white oil emulsion (excluding miscible oils) at a strength of 2·5 per cent., and as near the beginning of the reproductive period as practicable. The fact that about 90 per cent. of the survivors of oil spray treatments are adult females would justify the basing of results of such treatment on an examination of adult females only, and thus mortality determinations would be simplified and reduced in number.

Fig. 16.—An experimental block at Mildura.

Results of fumigation experiments have shown that a high mortality can be obtained with any of the three standard methods used. This would seem to indicate that fumigation might be improved not necessarily by increasing the toxicity of the fumigant, but by correctly timing the treatment, extending the period over which fumigation might be carried out (i.e., by beginning the treatment earlier, possibly even by winter fumigation), by studying the tolerance of trees to HCN and by the more careful application of the treatment itself.

The experiment on dosage rates indicated that, under the conditions of the experiment, an increased dosage of 37·5 per cent. did not give a 100 per cent. mortality, but on the other hand a decrease of 12·5 per cent. did not result in reduced mortality. Thus, it is evident that factors other than dosage cause the variation in results experienced in commercial fumigation. The application of liquid HCN by means of the accurate and convenient type of pump used is greatly superior to any previous method of applying it (Fig. 15).

Efficient application of insecticides alone will not solve the red scale problem in a citrus grove. The weeds growing in the grove where the insect is prevalent are usually infested, and unless their destruction is included in the control programme they will provide a source of reinfestation for treated trees. The preparation of a grove for control treatment would include the destruction of weeds, and the skirting of the trees so that no part of them is resting on the ground.

Summary.

In Victoria, red scale constitutes the major biological problem of the citrus industry. The warm dry climate prevailing in the citrus areas is very favourable to the propagation and survival of the insect. Control measures adopted by the growers have given very variable results, indicating the need for improvements in methods used, and for a clear definition of how and when to combat the insect. An investigation of the problem was begun in April, 1935.

Preliminary statistical studies on the natural mortality of red scale on 48 citrus trees at Bamawm formed the basis of the method of sampling the population before and after applying treatments, and the laying out of experimental plots.

A year's studies on the seasonal activities of the insect at Bamawm showed that between May and November reproduction did not occur, although during this period feeding and growth continued. During the non-reproductive period the natural mortality of the insect reached a peak at 83 per cent. just prior to the commencement of reproduction in November. The most active breeding period was December to April. An outline of the life-history as it occurs in Victoria is given.

Insectary studies at Burnley showed that with the mean daily temperature of 72 deg. F. the life cycle (i.e., from birth to reproduction) occupied 69 days; the female may live and reproduce for an additional 60 days, thus the total life of the female averaged 129 days. Up to 145 larvae were produced by each female during its lifetime, and in some cases as many as eleven per day.

Laboratory tests on four brands of oil emulsion and two brands of miscible oil, when all were used at a common strength of 1·5 per cent., gave indications of inferior control with the latter type of preparation. Chemical analyses of the oils showed that the oil emulsions contained approximately 16 per cent. less emulsifying agent than the two miscible oils. The inferiority of the latter group is attributed largely to the proportion of emulsifying agent present.

Field trials with these oils on replicated plots were conducted at Bamawm. The oils were applied at a common strength of 2·5 per cent. The results of these trials were in accord with the findings of laboratory tests; they showed that the oil emulsions tended to result in a greater kill of red scale than did the miscible oils. Thus, on leaves the emulsions gave 98·8 per cent. control and the miscibles 97·3 per cent. In general the oils gave slightly less effective control on fruit than they did on leaves. Seventy-one per cent. of the fruit harvested from oil-sprayed plots, eight months after spraying, was still infected with scales, and the fact that 86 per cent. of these were dead indicates that weathering-off of scales killed by a treatment cannot be relied on to free the fruit of the dead insects.

Comparative trials of various strengths of an oil emulsion spray indicated that a satisfactory strength at which to use the material against red scale was 2·5 per cent. in water (i.e., 1 in 40).

Time-of-spraying trials in which summer and autumn sprayings were compared showed that the best treatment consisted of two summer spraying applied in December and January. This treatment resulted in a 98·8 per cent. kill, and produced 27 per cent. of scale-free fruit at harvest. A single summer spraying, also a summer and autumn treatment produced only 10 per cent. of clean fruit (and a 97·4 per cent. kill). An autumn spraying alone resulted in a 95·8 per cent. kill, and only 0·1 per cent. of scale free fruit. The relatively low proportion of clean fruit obtained even from plots receiving the best treatment shows that when the infestation is severe even a 1·2 per cent. survival of scales may be serious. Under such conditions thorough sprayings for several years would appear to be necessary to control the insect.

Field fumigation trials showed (i) that Liquid HCN, "Cyanogas" dust, and "Calcid" briquettes were equally effective in destroying red scale, and caused an average kill of 99·7 per cent.; (ii) that doses of liquid HCN 12·5 per cent. below the standard did not result in reduced kill, and 37·5 per cent. above the standard did not give 100 per cent. kill nor cause additional tree injury, under the conditions of the experiment; and (iii) that fumigation of fully-grown fruit two months before harvest was not effective in producing scale-free fruit, as 99 per cent. of the fruit was infected with dead scales at harvest.

Chemical determinations made during the fumigation experiments showed for each treatment the gas concentrations reached, the rate of leakage of gas from the fumigation sheets, and the concentrations at different parts of the tree.

References.

1. Bodenheimer, F. S.—Contributions towards the knowledge of Red Scale in Palestine. Rev. App. Ent. 22 A, 10, p. 553, 1934.
2. Pratt, F. S., Swain, A. F., and Eldred, D. N.—Studies of Auxiliary Gases for Increasing the Toxicity of Hydrocyanic Acid Gas. J. Ec. Ent. 28, pp. 975–982, 1935.
3. de Ong, E. R.—Petroleum Oil as a Carrier for Insecticides and as a Plant Stimulant. Rev. App. Ent. 17 A, 9, pp. 512–513, 1929.
4. de Ong, E. R., and Knight, H.—Emulsifying Agents as an Inhibiting Factor in Oil Sprays. J. Ec. Ent. 18, 2, 1925.
5. Ebeling, W.—Experiments with Oil Sprays used in the Control of California Red Scale on Lemons. J. Ec. Ent. 25, 5, 1932.
6. Klein, H. Z.—On the Biology of Red Scale in the Jordan Valley. Rev. App. Ent. 24 A, 8, p. 477, 1936.
7. Knight, H.—Factors Affecting Efficiency in Fumigation with HCN. Hilgardia 1, 3, 1925.
8. Knight, Chamberlain, and Samuels.—On Some Limiting Factors in the Use of Saturated Petroleum Oils as Insecticides on Living Plants. Phytopathology 19, 12, p. 1136, 1929.
9. Knight, H., and Cleveland, C. R.—Recent Developments in Oil Sprays. J. Ec. Ent. 27, 1, pp. 269–279, 1934.
10. Moore, W.—Fumigation Experiments with California Red Scale under Orchard Conditions. J. Ec. Ent. 27, 5, pp. 1042–1055, 1935.
11. Woodhill, A. R.—The Citrus Red Scale. N.S.W. Agr. Gazette, XLI., 2, p. 125, 1930.
12. Provan, J. L.—Fumigation of Citrus Trees. J. Dept. Agric. Victoria 32, 12, 1934, and 33, 1, 1935.
13. Quayle, H. J.—Spray and Fumigation Combination for Resistant Red Scale. J. Ec. Ent. 20, 5, 1927.
14. Arthur, J. M., and Harrison, T. H.—Calcium Cyanide for Fumigation of Citrus. N.S.W. Agr. Gazette, XXXVII., 3, pp. 245–248, 1926.
15. Rohrbaugh, P. W.—Penetration and Accumulation of Petroleum Spray Oil in Leaves, Twigs, and Fruit of the Citrus Trees. Pl. Physiol. 9, 1934.
16. Smith, R. H.—Experiments with Oil Sprays in Controlling Red Scale. Rev. App. Ent. 17 A, 7, p. 392, 1929.
17. Smith, R. H.—The Tank Mixture Method of Using Oil Spray. Cal. Agr. Exp. Sta. Bull. 527, 1932.
18. Summerville, W. A. T.—Queensland Citrus Scale Insects and Their Control. Queens. Dept. Agr. and Stock Div. Ent. and Plant. Path. Bulletin 10, 1934.
19. Swain, A. F., and Buckner, R. P.—Fumigation of Citrus with a Tent Form. J. Ec. Ent. 28, 6, pp. 983–989, 1935.

20. Hely, P. C.—Citrus Red Scale Experiments with Liquified Hydrocyanic Acid Gas Fumigation. Agric. Gazette, N.S.W., Nov. 1933, pp. 823–26.
21. Woglum, R. S., and La Dollette, J. R.—The Double Treatment for Scale Pests in Californian Citrus Orchards. J. Ec. Ent. 27, 5, pp. 978–980, 1934.
22. de Ong, E. R., Knight, H., and Chamberlain, J. C.—A Preliminary Study of Petroleum Oil as an Insecticide for Citrus Trees. Hilgardia 2, 9, pp. 351–384, 1927.
23. Clarke, S. W., and Friend, W. H.—Bull. No. 445, Sept. 1932, Texas Agr. Exp. Station. Calif. Red Scale and Its Control in the Lower Rio Grand Valley of Texas.
24. Borden, A. D., and Hensill, G. S.—A Method of Studying Comparative Oil Deposits of Proprietary Oil Emulsions. Jour. Econ. Ent. 27, pp. 834–841, Aug. 1934.

Chicken Feeding Tests *(Continued from page 376)*

The chickens fed with the Werribee chick mixture looked better and stronger than those in Group 2 (Soaked Wheat) and the weights show that they were much heavier.

The cost of food in Group 1 was about threepence per chick more than was the case with Group 2, fed with the soaked grain. However, the growth and stamina of the chicks are the most important factors, and it is considered that the slight saving in food cost was more than offset by the improvement in this regard, and the test may be taken to indicate that under the conditions prevailing the Werribee chick mixture is to be preferred to the soaked wheat ration for feeding young chickens.

The only death recorded was in Group 2, one chicken dying on the seventh day of the test.

Orchard and Garden Notes *(Continued from page 395)*

been done in orchards where there was an infestation of aphis last season, a good nicotine sulphate spray should now be given.

Peach trees must be sprayed for prevention of leaf curl attack just before the buds burst in early spring. The trees should be sprayed with Bordeaux mixture at the 6:4:40 strength.

Plums and prunes should be sprayed for prune rust with Bordeaux mixture of the same strength just as the buds begin to swell in early spring. A second spray should be given to plums at half strength, that is, at the 6:4:80 strength—this means 80 gallons of water instead of 40—after the petals have fallen.

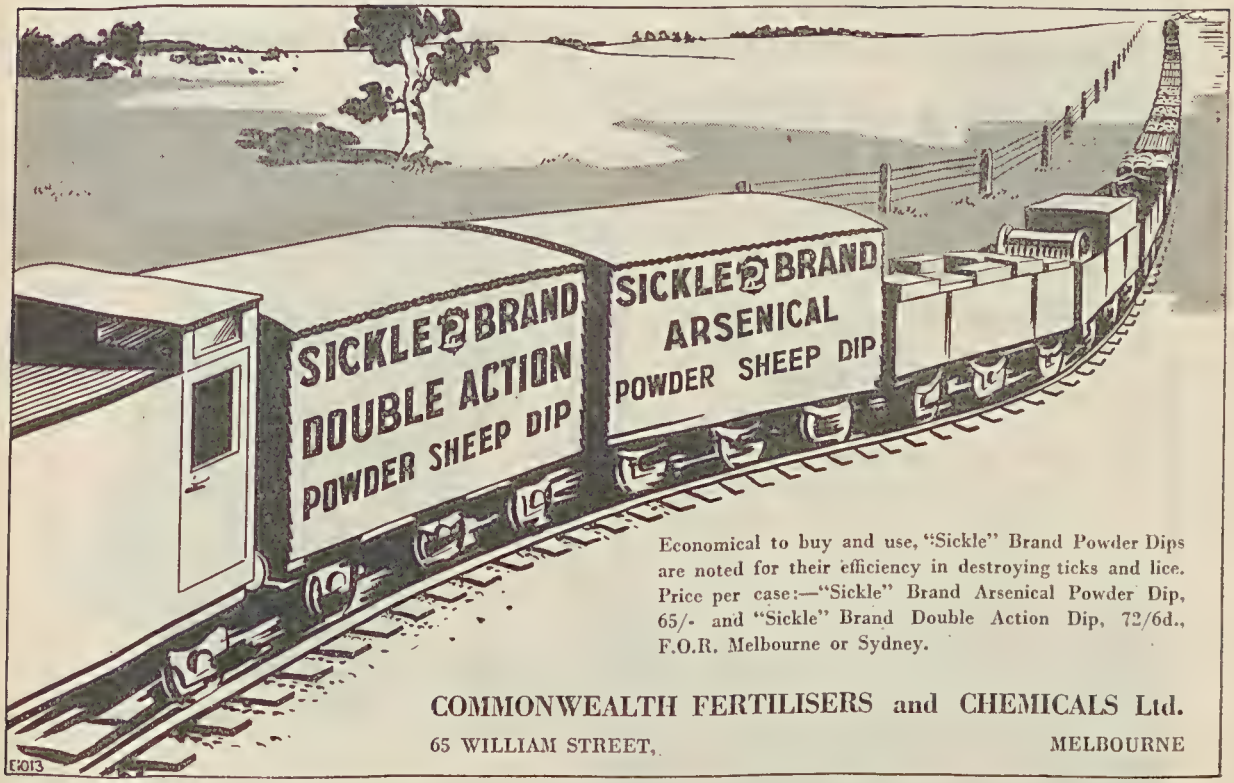
For shot hole and scab of apricots the trees should be sprayed with Bordeaux mixture of the usual strength when the buds are at the pink stage in early spring. An amount of 1 lb. of lime casein should be added to every 100 gallons of spray.

Tubercle Free Herds

The following herds have been declared free of tuberculosis under the scheme conducted by the Department of Agriculture. Under this scheme a tuberculosis-free accredited herd of cattle is one in which the entire herd has passed two negative, successive, annual physical examinations and tuberculin tests, or, upon disclosure of infection, three semi-annual, successive physical examinations and tuberculin tests applied by a State Veterinarian or by a qualified and registered veterinarian who is approved by the Chief Veterinary Inspector for that purpose.

ACCREDITED TUBERCLE FREE HERDS.

Herd Number.	Name.	Address.	Number in Herd.	Herd Number.	Name.	Address.	Number in Herd.
1	State Research Farm	Werribee ..	259	6	Lady Talbot Milk Supply Company	Cranbourne ..	418
2	Warragul High School	Warragul ..	35	7	Mailer, Dr. Ramsay ..	"Maneroo," Shepparton	92
3	Payne, A. E. T. ..	"Yarra View," Lilydale	80	8	Reid, Ralph G. ..	"Holmwood," Koo-wee-rup	99
4	Dennis, Mrs. A. A. ..	Frankston ..	14	9	Harris, J. W. ..	"Rowena," Clyde	72
5	Slaney, H. B. ..	Mornington ..	85				



Economical to buy and use, "Sickle" Brand Powder Dips are noted for their efficiency in destroying ticks and lice. Price per case:—"Sickle" Brand Arsenical Powder Dip, 65/- and "Sickle" Brand Double Action Dip, 72/6d., F.O.R. Melbourne or Sydney.

COMMONWEALTH FERTILISERS and CHEMICALS Ltd.
65 WILLIAM STREET, MELBOURNE

Write for Booklet:
"Better Yields by Spraying with ESA Bluestone."

BLUESTONE
ESA BRAND

Manufactured by
The Electrolytic Refining and Smelting Company of Australia Limited, Port Kembla, N.S.W.

Guaranteed to contain not less than 99% Sulphate of Copper.

USE IT—

In preparation of Spray Mixtures for Fruit Trees and Vines . . . For Treatment of Foot-rot in Sheep . . . To prevent Liver Fluke in Sheep . . . As a Drench for Worms in Sheep and Scour in Calves . . . For wheat pickling.

Agents for all States:
ELDER SMITH & CO. LTD.
ALL CAPITAL CITIES.

YOU GET THE BEST BY USING THE BEST

COCKBILL'S

BLOOD & BONE
BLOOD, BONE, & SUPER.
MEAT MEAL
BONE MEAL
BONE GRIT
NEATSFOOT OIL

J. COCKBILL
407 POST OFFICE PLACE, MELBOURNE, C.1
TELEPHONES—CENTRAL 2097, 2098

LYSAGHT'S

100% Australian Made 100%

Fencing and Other Wires, Wire Netting, Zinc Oxide.

Our Netting and Other Products are known through the Commonwealth as of the highest standard. Obtainable from all leading Merchants and Storekeepers.

LYSAGHT'S AUSTRALIAN MADE WIRE NETTING PROOF SYDNEY N.S.W.

Look for Our Marker in Every Roll of Netting.

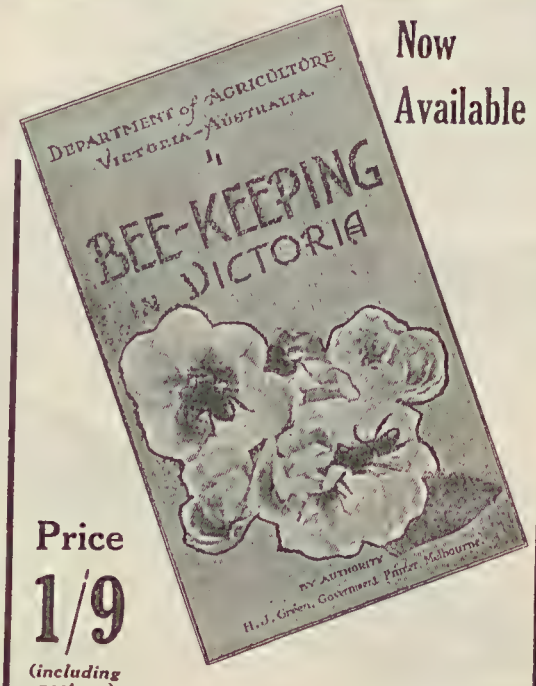
Manufactured by

Lysaght Bros. & Co. Ltd.

Head Office: 17-19 Bridge Street, Sydney
Works: Parramatta River

Agents for Victoria: Gibbs, Bright & Co., 34 Queen Street, Melbourne

Now Available



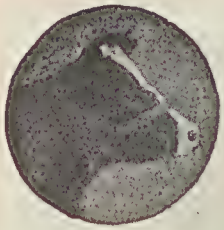
Price 1/9 *(including postage)*

A NEW EDITION of "Beekeeping in Victoria," a comprehensive book in which beekeeping practices are fully described, has been published by the Department of Agriculture.

This publication, which contains 165 pages, is well illustrated, and should be of interest not only to commercial apiarists, but also to those who desire to carry on bee culture as a hobby or side-line to other occupations.

Obtainable from

The Director,
Department of Agriculture,
Melbourne, C.2



Stud Breeders' CARDS

Leading Red Polls

"GIPPS" RED POLLS

The well-established herd of Red Poll Cattle at Warragul High School.

Young Bulls, Heifers, and Tested Females for Sale.

INSPECTION CORDIALLY INVITED.

Inquiries to the Head Master,

WARRAGUL HIGH SCHOOL

Important Jersey Sale

IMPORTANT SALE of the "Grangelea" Proven Reg. Jerseys

On behalf of Mr. A. A. Broad

ADAMSON, STRETTLE & Co. Pty. Ltd., 396 Bourke Street, Melbourne, have received instructions from Mr. A. A. Broad to sell, on Thursday, 28th October, at "Grangelea," Sutton Grange, 70 head of high-class Government-tested Jerseys, mostly young cows and 2-year-old heifers, due to calve in September and October. Balance will be young cattle. Jersey enthusiasts will welcome this announcement, as the Herd is widely known. Catalogues will be available later on application.

Poultry

WHITE LEGHORN Chickens and Eggs

From selected well-bred hens mated to cocks bred from tested stock.

PARTLY-REARED CHICKENS £5 per 100
DAY-OLD CHICKS .. £4 per 100
HATCHING EGGS .. £1 10s. per 100

Delivery from August onwards. Satisfaction guaranteed.

L. MAGNUSSON, Private Bag, NATHALIA

Poultry

Week-old PULLETS Week-old

Week-old and partly raised at day-old prices—
Free Brooding Service for 1st week

PULLETS—White Leghorns, £5 17 6 per 100; B. Orp., £6 6 0; R.I. Reds, £6 6 0 per 100

UNSEXED—White Leghorns, 57/6 per 100; B. Orp., 67/6; R.I. Reds, 70/- per 100

COCKERELS (few days old)—White Leghorns, 7/6 per 100; B. Orp., 35/-; R.I. Reds, 37/6 per 100

CHICKENS FORWARDED ANY DISTANCE. SATISFACTION GUARANTEED.

HOCKEYS' BENTLEIGH HATCHERY,
7 LORANNE St., BENTLEIGH. Phone XU 1671

Leading Friesians

THE VICTORIA FRIESIANS

The Friesian Herd conducted by the Department of Agriculture at the Werribee Research Farm includes some of the most consistent producers in Victoria.

Males and Females For Sale. *Inspection cordially invited.*

DEPARTMENT OF AGRICULTURE
MELBOURNE

Advertising Rates

STUD BREEDERS' CARDS

Advertisements for this section accepted at following rates:—

12 months - **15/-** per insertion
6 months - **17/6** per insertion
1 to 3 months - **£1** per insertion

For further particulars write to

Director, Department of Agriculture
MELBOURNE, C.2.

THE VICTORIA HERD

of Red Poll Cattle

Maintained for Milk and Beef at the State Research Farm, Werribee.

BULL CALVES

Six For Sale at Reduced Prices

No. 1. VICTORIA DONALD. (AA, C.R.). Born 16th March, 1935 *Price* 40 guineas
Sire: Woodburn Peter Pan (Imp. in utero) (1504 AA). *Dam:* Victoria Rose Major (5AA). f.o.r. Werribee.
Victoria Rose Major produced 455 lb. butter-fat in 273 days, and 531 lb. in 365 days. (An AA Bull).

No. 2. VICTORIA VALHALLA. (A, C.R.). Born 14th December, 1935 .. *Price* 20 guineas
Sire: Chandpara Valentine (762 AA). *Dam:* Victoria Asphodel (3008 A). f.o.r. Werribee
Victoria Asphodel produced 322 lb. butter-fat as Jr. 4 (273 days).

No. 3. VICTORIA ST. PETER. (A, C.R.). Born 29th July, 1936 .. *Price* 15 guineas
Sire: Woodburn Peter Pan (Imp. in utero) (1504 AA). *Dam:* Victoria Kosher (3914 A). f.o.r. Werribee
Victoria Kosher produced 286 lb. butter-fat in 273 days as Sr. 3.

No. 4. VICTORIA DUTCHMAN. (A, C.R.). Born 19th November, 1936 *Price* 13 guineas
Sire: Woodburn Peter Pan (Imp. in utero) (1504 AA). *Dam:* Victoria Friesia (5060 B) f.o.r. Werribee
Victoria Friesia produced 264 lb. butter-fat in 273 days as Jr. 2.

No. 5. VICTORIA BLUE PETER. (A, C.R.). Born 12th February, 1937 *Price* 13 guineas
Sire: Woodburn Peter Pan (Imp. in utero) (1504 AA). *Dam:* Victoria Blue Eye (4883 A). f.o.r. Werribee
Victoria Blue Eye produced 308 lb. butter-fat in 273 days as Jr. 2.

No. 6. VICTORIA EROS. (A, C.R.). Born 7th April, 1937 .. *Price* 11 guineas
Sire: Chandpara Valentine (762 AA). *Dam:* Victoria Flirt (3906 A). f.o.r. Werribee
Victoria Flirt produced 369 lb. butter-fat in 273 days as Jr. 4.

Prices are based on the average butter-fat production of the dam in 273 days, except in the case of progeny of heifers without completed test, the price then being 10 guineas.

An amount of 2 guineas per quarter maintenance has been added to calves 3 months old and over.

Inspection cordially invited. For further particulars apply to—

THE DIRECTOR OF AGRICULTURE, MELBOURNE, C.2; OR THE MANAGER, STATE RESEARCH FARM, WERRIBEE

Flash Bute by Flashdale (1925)

Clydesdale STALLION and COLTS

For Sale

DEPARTMENT OF AGRICULTURE, VICTORIA

CERTIFICATED STUD BOOK CLYDESDALE STALLION and COLTS

All Sired by FLASH BUTE, C.C.S.B. 857

By Flashdale (Imp.) (20576).
by Dunure Footprint (15203 C.S.B.).
Flash Bute, Dam; Silver Bute (860 C.C.S.B.) by Baron Bute (Imp.) (15129 C.S.B.).
Grand Dam: Hiawatha Queen (C.C.S.B. 365) by Hiawatha of Australia (N.Z.S.B. 245).

1. Victoria Double Flash (Stallion)

Bright bay, foaled 24th October, 1932.
Sire: Flash Bute.
Dam: Victoria Lovelight (C.C.S.B. 2233) by Flashdale (Imp.) (C.S.B. 20576).
Grand Dam: Victoria Lovely (1604 C.C.S.B.) by Baron Wigton (Imp.) (13884).
This horse shows very good quality, and is a splendid mover.

2. Victoria Pasha

Dark bay, foaled 9th September, 1933
Sire: Flash Bute.
Dam: Victoria Patti (C.C.S.B. 1611) by Baron Wigton (Imp.) (C.S.B. 13884).
Grand Dam: Patricia (C.C.S.B. 714) by Baron Bold (A.C.S.B. 27).
A reachy colt with splendid conformation.

3. Victoria Lascar

Blue roan, foaled 3rd November, 1933.
Sire: Flash Bute.
Dam: Vic. Luscious (C.C.S.B. 1607) by Baron Wigton (Imp.) (13884 C.S.B.).
Grand Dam: Lucilla (C.C.S.B. 554) by Baron Bold (A.C.S.B. 27).
A heavy boned, weighty colt.

4. Three-year-old Colt

Sire: Flash Bute.
Dam: Duchess of York (C.C.S.B. 2230).
Grand Dam: Royalty (836 C.C.S.B.) by Baron Wigton (13884 C.S.B.).

All the above colts are available at prices to suit the farmer

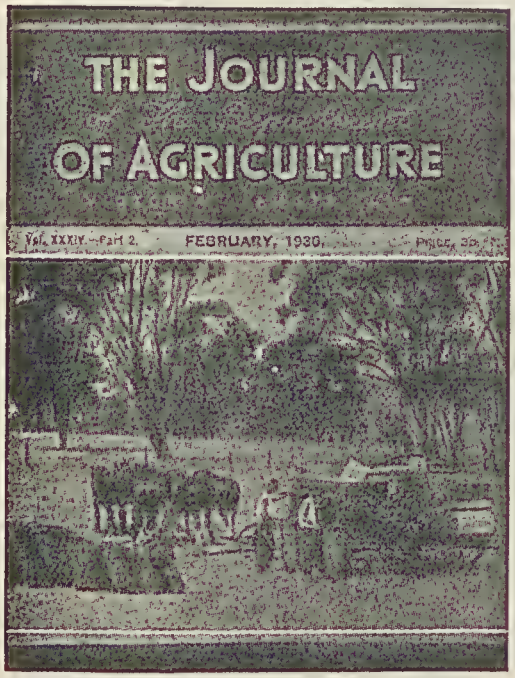
For further Particulars apply to—

The Manager, State Research Farm, Werribee

The Journal of Agriculture

OFFERS EXCEPTIONAL ADVANTAGES

for ADVERTISING



THE JOURNAL OF AGRICULTURE circulates widely throughout the country districts of Victoria and amongst farmers of the Commonwealth, reaching also country bankers, professional and business men, school teachers, &c. It offers exceptional advantages for the advertising of all goods required by the farmer and in the rural home

Only advertisements approved by the Department are accepted for publication in the *Journal*

The *Journal of Agriculture*—the Official Journal of the Department of Agriculture of Victoria—is published monthly and has a GUARANTEED CIRCULATION of

10,000 COPIES MONTHLY

Advertising Rates on Application to the Director, Dept. of Agriculture, Melb., C.2

Air-Conditioned Sitting and Sleeping Cars on Mildura Line Service . . !

Notable for their almost complete freedom from train noises, air-conditioned cars also provide a flow of dustless, purified air which is maintained at a constant, agreeable temperature regardless of outside weather conditions . .

In winter, for example, a footwarmer, overcoat, or other wrap is superfluous in an air-conditioned car . . .

Air-Conditioned Sitting and Sleeping Cars are attached to the Train from Melbourne to Mildura on Mondays, Wednesdays, and Fridays; and to the Train from Mildura to Melbourne on Tuesdays, Thursdays, and Sundays . . .

Seats (1st and 2nd class) may be reserved at 1/3d., or Sleeping Berths (1st class only) may be booked at 12/6d.

For further details and reservations, consult the Victorian Government Tourist Bureau, Queen's Walk, Melbourne (Branch Office, Spencer Street Station). Telephone—Central 2042.

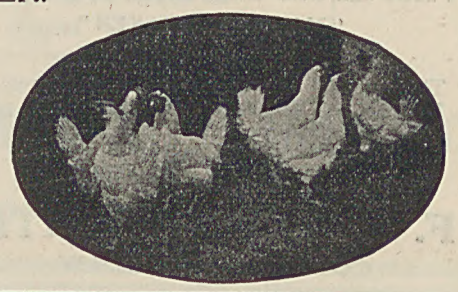
DEPARTMENT OF AGRICULTURE

White Leghorn and Australorp Eggs . .

FOR SETTING

Settings of White Leghorn and Australorp Eggs will be available from the State Research Farm, Werribee, during JULY, AUGUST, and SEPTEMBER.

Eggs from single-mated birds	**2 gns. a setting of 16**
Eggs from hens mated to pedigreed cocks ..	**1 gn. a setting of 16**



Apply to—

The Manager, State Research Farm, Werribee

Is a simple arrangement that multiplies the power at the handle 260 times—handy to use, easy to move, quickly rigged, and works in roughest country. Standard equipment pulls trees and stumps from 1½ acres without changing anchor. Many other time- and labour-saving features. Catalogue with pleasure.

TREWHELLA BROS. PTY. LTD., TRENTHAM

THE PRACTICAL MAN
MAKES AN EARLY START

WISHING that you were lucky enough to be wealthy is of no practical value in building up your bank account. The only reliable way to independence is to save systematically. Make an effort to start; the result will be well worth while, for you have everything to gain, and nothing to lose. The right place for your savings is—

THE STATE SAVINGS BANK OF VICTORIA

J. THORNTON JONES, General Manager
Head Office: Elizabeth St., Melbourne.

Paspalum Seed for Sale

PASPALUM DILATATUM SEED
"MACHINE SHAKEN"
(Seed for Sowing)

The heaviest sample on the market to-day. 1s. 2½d. per lb., half-ton and over 1s. 2d. per lb., F.O.B. Sydney, or freight paid to any railway station in Victoria or N.S.W.

Sample on application. Cash with order.

F. L. LONGWORTH
COOPERNOOK, N.S.W.

Red Polls

THE VICTORIA RED POLLS
The largest Registered Herd-tested Red Poll Stud in the Commonwealth.

BULL CALVES FOR SALE

The progeny of Tuberculin-tested stock and of cows tested in the Standard Herd Test. All are eligible for registration in the Red Poll Herd Book of Australia.

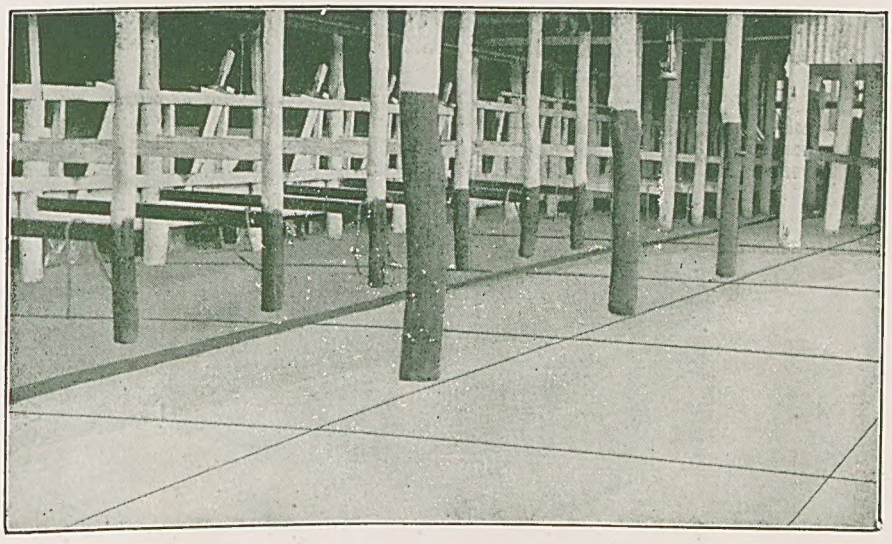
INSPECTION CORDIALLY INVITED

For further particulars apply to
THE DIRECTOR OF AGRICULTURE, MELBOURNE, C.2,
OR THE MANAGER, STATE RESEARCH FARM, WERRIBEE

H. J. Green, Government Printer, Melbourne.

CONCRETE

The Hygienic Servant of the Farmer and Grazier



Concrete Cow Bails

USE

"ARC" Brand GEELONG Cement

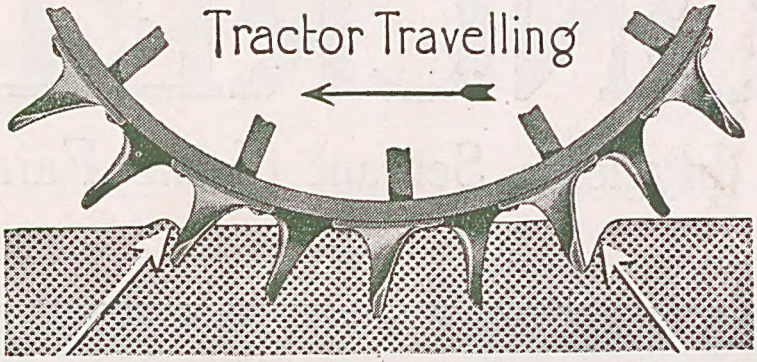
Write to us for Free Information *re* Uses of Cement on the Farm

AUSTRALIAN CEMENT LIMITED

TEMPLE COURT, 422 COLLINS ST., MELBOURNE, C.1

Telephone : **Central 1773 (4 lines)**

Gear your Tractor to the Soil



Note forward push:
The Grip when penetrating the soil slides forward on its concaved face, removing all resistance by its unique shape and set.

Note space gained between point of entry and exit. The Grip leaves the soil on its reverse face, being lifted—propeller-like—by the turn of the wheel.

There's no need for extra weights or loading upon tractors equipped with—

They gear the tractor to the soil; prevent wheel slipping and ensure 100% efficiency at the drawbar. Just see above how they function in the soil

Stocks available in all States. Sold by every Reputable Tractor Distributor or Dealer.
Whether purchasing a new Tractor or re-equipping your old one,
INSIST ON "McGREGOR" GRIPS

MANUFACTURED BY—

McGREGOR WHEEL GRIP & ENGINEERING Pty. Ltd.

67-75 RODEN STREET, WEST MELBOURNE

SP
630.45
V645